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A FRAMEWORK FOR UNDERSTANDING THE PUBLIC'S PERSPECTIVES OF MINING APPLIED TO THE KENTUCKY COAL INDUSTRY

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A FRAMEWORK FOR UNDERSTANDING THE PUBLIC'S PERSPECTIVES OF
MINING APPLIED TO THE KENTUCKY COAL INDUSTRY

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
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Abstract

A FRAMEWORK FOR UNDERSTANDING THE PUBLIC'S PERSPECTIVES OF
MINING APPLIED TO THE KENTUCKY COAL INDUSTRY

People's perceptions of mining are heavily based on the media they consume and the messages therein. News outlets ordinarily report on mining only when there is an accident or environmental concern. When messages that the public is exposed to are negative, it is no wonder that there are negative perceptions about mining.

Current public relations campaigns on the behalf of specific companies or select sectors do exist; however, this is often a reactionary move in response to recent shifts in the socio-political environment. The details of these campaigns are often tied up in proprietary information or withheld by public relations firms. Hiring public relations firms is often cost prohibitive for many single mining companies.

Mining serves a vital purpose in providing society with the base resources to sustain the standard of living it has come to expect. This important purpose needs to be fully communicated to the public in order to educate them. Attitudes about mining need to be identified so misinformation can be accurately targeted. Before this can begin, these attitudes must be measured and knowledge gaps identified.

This work focused on two main objectives on the mining industry's behalf. The first focus was to determine attitudes towards mining and knowledge about mining. This was done through a survey administered to three counties in Kentucky. From this survey, guidance for communication efforts were produced, through the suggestion of specific topics for messages, which directly addresses identified attitudes of the public and misconceptions about mining. Relationships between knowledge and attitudes were explored, as well as relationships between demographic information and knowledge, and attitudes. Subsequently, an empirical model for predicting individuals' knowledge of mining was produced. The second focus was to apply theoretical foundations to educational and community engagement efforts. Different theories are required for different groups of people depending on the level that mining plays a role in those peoples' lives. In all, how the mining industry communicates with the public needs to be improved, and the work proposed here will steer these improvements.

KEYWORDS: Mining, Public Communication, Public Survey, Attitudes, Community engagement

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4/24/13
Date

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By

Joshua Micah Hoffman

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_____
Dr. Braden Lusk
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Dedicated to:
My Line
They that have
and
They that have yet

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 Prelude

Communication with the public is not taught to mining engineers. So why then does a mining engineer choose to base a dissertation on the subject? Why put myself through the scrutiny of fellow engineers who feel it's a lesser topic? Why take on a task outside of my initial education which meant learning about entirely different fields of study? Why not utilize the technical research that paid my stipend for a dissertation? Though the answer is simple, it was not easily taken up. It is because I truly believe this work is important. Important to the degree that it is vital to the future of the mining industry. This body of work is a culmination of a persistent thought I had while working on my undergraduate degree and one that stuck with me for several years. It started while sitting in my mining management course one day when the professor made a comment similar to: "Politicians and the public just don't know why we mine." All I could think was, "Why not?" Why do we not tell them, teach them, and communicate with them? Why wasn't there some campaign to educate the public about the purpose of mining? How can we better communicate about the purpose of mining? What does the public really know about mining? This body of work began with doubt. Doubt became the narrative. This work was driven by doubt that sufficient answers to these questions existed. So when given the opportunity to start searching for answers, I took it. Though the public's perspective of mining may be negative, it should be known why it is negative so that solutions can be applied. The purpose of this work was to address the issue of the publics' perspective of mining, understand it better, and create paths for improving it. In the end there are still questions, but it's a start, a contribution, and something I'm happy that I did.

2.0 Introduction

The mining industry as a whole has a simple, critical, and necessary role in our world. Mining provides us with the raw base resources that are refined into virtually every product, service, and luxury at the disposal of modern society. In the author's opinion, if this fundamental need was not met by the mining industry, civilization would cease to exist due to the negative perception held by the populace. While it can be argued that no business can exist without the consent of its customer, for without customers there would be no commerce. Mining continues to exist because there continues to be consumers of goods derived from mining. It is argued that consent is not what keeps the mining industry in existence, rather a simple fundamental purpose. The purpose of mining is to provide humanity with the base materials to maintain an ever advancing and globally expanding standard of living. This purpose is held by no competition other than recycling. Were there an alternative with a better image in the public's eye it would have been heralded in, and mining would have been done away with. This, however, is not the case, and will not be in any foreseeable future. As a result, the mining industry exists not because consumers directly identify their reliance upon it but because they are unwittingly dependent upon it. This disconnect, between the resources that lay beneath the ground, the practices to recover them, and the newest electronic device coveted by the masses, must be bridged. Mining has a vital purpose of providing society with the resources to sustain the standards of living it has come to expect. This purpose needs to be fully communicated to the public in order to educate them, and attitudes about mining need to be identified so misinformation can be accurately targeted.

The publics' perspective of the mining industry is thought to be a negative and ambiguous one by those involved with the mining industry. It is negative in that the idea of mining often invokes general feelings of discomfort, and at the same time, specific facts about mining (Which states have mines?, How much land does mining affect?) are unknown to most (Bingham, 1994). Mining is typically only brought into the national spotlight of news media for a few reasons. For the most part these reasons include mining accidents or destruction of the environment. The images associated with mining often mirror those produced by entertainment media. Thus, a stereotype has been formed

for the typical miner and the typical mine, and both are negative. When historical content of mining is applied to modern context severe misconceptions are formed.

Since education at the grade, high school, or colligate level does not include information about mining, people's perceptions of mining are heavily based on the media they consume and the messages therein. Whether the messages are found in news media or entertainment they are, by and large, negative about mining. It could be argued that many of the depictions of miners, mining companies, and actual mines are discriminatory stereotypes. News outlets ordinarily report on mining only when there is an accident or environmental concern. When these are the messages and images that the public is exposed to, it is no wonder that there are negative perceptions about mining.

Current public relations campaigns on the behalf of specific companies or select sectors do exist. For example, coal has been at the forefront of the most notable of recent efforts; however, this has been a reactionary move due to recent shifts in the socio-political environment. Public relations and advertising firms are the professionals in the field of public relations campaigns, but at the end of the day, companies must preserve their standing in their market. As a result, the details of these campaigns are often tied up in proprietary information or withheld by public relations firms. Hiring public relations firms is often cost prohibitive for many single mining companies.

The model suggested in this body of work for an educational campaign on behalf of the mining industry is comprised of the following three phases: design, implementation, and evaluation. While a budget will affect the scale of efforts and magnitude of effects, it should not govern which phases are conducted as all are necessary for an effective campaign. The campaign design phase would include choosing a theoretical foundation, setting measurable and obtainable goals, formative research, and media outlet selection. Implementation would involve carrying out sufficient message delivery to the intended audience to produce the desired results. Evaluation is critical for gauging whether or not a campaign had the intended outcome. Carefully choosing measurable outcomes during the design phase is critical for determining if a campaign is successful since success can only be determined if it can be measured. All three phases would be framed through the lens of available funding.

The current study focuses on the first phase of design. Specifically, the theoretical foundation rationale, future effect metrics, and conducting the formative research that will aid in the latter phases of an educational campaign about mining. Social Judgment Theory (SJT) was selected for the theoretical foundation for this work. SJT is a persuasion theory that postulates that messages are compared to other attitudes and stances that an individual holds and they are, or are not, persuaded by the message based on how close it is to their current beliefs (Sherif, 1963). The theory and application of this theory are elaborated upon in Sections 3.4.1 and 5.1. The following effect metrics were chosen: attitudes about mining, knowledge of mining, and actions affecting mining. These are further discussed in greater length in subsequent chapters.

Before effective educational efforts can be designed and implemented, formative research must be conducted to fully understand the scope of the problem, the audience that is to be educated, and the internalized barriers members of the audience have. A survey was used to determine the publics' attitudes and knowledge about mining. Approximately 300 surveys were administered to Kentuckians in three counties. These counties were selected primarily based on the amount of coal mining within their borders for the purpose of making comparisons between regions with different levels of mining activity. The surveys measured both knowledge of mining and attitudes about aspects of mining.

Analysis of this survey revealed the attitudes about mining, their knowledge of mining, and actions related to mining within each of the Kentucky counties. This study has laid down the foundation for guidance on educational efforts about mining in Kentucky as well as provided a framework for future education.

This study can positively influence the educational choices of companies and regional grassroots organizations alike. Therefore, the messages communicated on behalf of the mining industry can be ones that directly address the concerns of the majority rather than what it is the industry assumes the public should know about mining. In the end, this work aimed to better understand the intended audience so that specific and more effective messages can be utilized.

3.0 Rationale

The core research questions which this work sought to answer are as follows:

- What are the attitudes about mining and knowledge of mining of the surveyed population?
- Can knowledge be predicted from demographic information?
- Are there relationships between attitudes and demographic information?
- Is there a relationship between an individual's self report of knowledge about mining and their tested knowledge about mining?
- Is there a relationship between tested knowledge about mining and attitudes of mining?
- What are the actions that the public takes that can affect mining, and how can those actions be explained with the metrics of attitudes and knowledge?
- What can be done to improve the perceptions the public has about mining?

3.1 What does the public know about Mining?

To ask what the public knows about mining is to ask what the public has been taught about mining. Is mining something that we once did a long time ago and still do just so companies can make more money? Or, is it at the very base of our civilization as we know it with all its luxuries and amenities? The answer to this question can be linked to who does the teaching. One does not have to sit in a classroom and be lectured in order to be taught. Learning can take place anytime and anywhere, be it through conversation or through entertainment. Knowledge does not have to be sought out to be absorbed.

The image of mining could be shaped by the medias' portrayal of exactly what mining entails. These portrayals are often out of date or biased against the industry. Stereotypes have formed about mines and miners alike. These stereotypes have been made socially acceptable and are perpetuated by the selectivity of news stories about mining, as well as the manner in which miners are depicted in entertainment.

Three fronts are briefly discussed from which people experience a portrayal of the mining industry. First, how the news media choose to cover mining and what stories they

report is important to consider. Framing takes place in the choice of what particular stories to report and the tone in which those stories are reported (Breed, 1955; Gans, 2004). News stories are usually about mining accidents or the negative environmental impacts of mining activities. A brief landscape assessment was conducted on the websites of the four major network's websites. The query, "Coal Mining", was entered to see what types of stories were recently reported by each outlet. Second, mining is usually just a background setting or element in entertainment. Misconceptions are created when these elements of the past are applied to modern mining. Miners are victims of frequently accepted stereotypes. Third, books provide an avenue for continued self-education. Those who desire to learn more about a topic can seek out books on that subject. To get an idea of what types of printed books are available for someone who wishes to learn more about coal mining, Amazon.com was consulted. By taking a look at these sources an idea can be formed about what messages the public is being exposed to in regard to mining and thus, what is being learned. If a prevailing image of negativity is found in mainstream media then it is expected that the public would also hold negative attitudes towards mining.

3.1.1 Portrayal in the News

If the majority of what is known about the day to day events of the world is provided by news, then the manner in which topics are depicted can heavily influence the perception of these topics. This framing takes part in the selection of particular stories and the journalist's personal influence in the diction of the story itself (Breed, 1955; Gans, 2004). Again, these portrayals of the coal mining industry are accident or environmental harm centered. The benefits of coal mining are almost never covered nor are the reclamation efforts that restore the land after mining activities have ceased.

To obtain a snapshot of the types of stories currently covered, a brief assessment was completed on four major network's news websites. The query, "Coal Mining", was entered to see what types of stories were recently reported by each outlet. The top stories from each website were noted and reviewed. The results of this audit can be seen in Table 3.1.

Table 3.1 News Outlets and Headlines about Coal Mining

News Outlet	Query	Headline
http://www.foxnews.com	Coal Mining	Touring a Coal Mine
http://www.foxnews.com	Coal Mining	As West Virginia Coal Companies Expand, Graves Vanish
http://www.foxnews.com	Coal Mining	Explosion in Coal Mining Province of China Kills at Least 43, Injures 28
http://www.foxnews.com	Coal Mining	Cambrian Mining agrees to Canadian Coal Takeover
http://www.foxnews.com	Coal Mining	12 Dead After Coal Mine Explodes in Poland
http://abcnews.go.com/	Coal Mining	New Surface Mining Head Has Cautious Approach
http://abcnews.go.com/	Coal Mining	EPA will review 79 Mountaintop coal mining permits
http://abcnews.go.com/	Coal Mining	Kennedy Calls Mountaintop Removal Mining a Crime
http://abcnews.go.com/	Coal Mining	Mining Still a Dangerous Job
http://abcnews.go.com/	Coal Mining	North Dakota Regulators Toss Coal Mining Complaint
http://www.cbsnews.com	Coal Mining	Under One Danish Roof, Humanity Talks Climate
http://www.cbsnews.com	Coal Mining	Feds Visit Ky. To Push Black Lung Battle Plans
http://www.cbsnews.com	Coal Mining	Gas Explosion Kills 19 Turkish Miners
http://www.cbsnews.com	Coal Mining	19 Turkish Miners Dead in Mine Collapse
http://www.msnbc.msn.com	Coal Mining	EPA to review mountaintop mine projects
http://www.msnbc.msn.com	Coal Mining	Windy twist to battle over coal mining
http://www.msnbc.msn.com	Coal Mining	Coal country worried about EPS reviews
http://www.msnbc.msn.com	Coal Mining	EPA to review 79 coal mine permits
http://www.msnbc.msn.com	Coal Mining	Mountaintop mining loses court battle

Of the stories identified in this search, only one covered mining from a positive perspective. Six stories covered mining accidents that resulted in deaths or injuries. Eleven stories covered environmental aspects of mining. Finally, one story covered the business aspects of mining.

It is important to note the fatality stories were all from countries other than the United States. Mining practices and the efforts in regard to safety are radically different

from country to country, yet this differentiation is not taken into account when forming a perception about the risks of coal mining specifically in the United States.

In the news, the Environmental Protection Agency (EPA) tends to be the target of much criticism in regard to how it reviews mining permits. This may be a concern that warrants investigation, but what about the success stories that result from the EPA's efforts? What about the release of multimillion dollar bonds due to proper reclamation activities?

These stories are not the only ones worthy of news reporting. The increase of safety standards and reclamation efforts by large companies are virtually unknown and are in need of being reported. Even when a story has input from two opposing sides, the coal industry is poised to be in the defensive position against criticism. This process influences what is perceived to be typical for mining operations. People, by and large, only hear about mining in the news when there is an accident or the environment is threatened. The assumption that all coal mining takes place in this manner is instilled in the population and constantly reaffirmed.

3.1.2 Mining in Entertainment

It is known that when messages are imbedded in entertainment they become more effective (Wicks, 2006). This is because they lose the direct appearance of being a lesson, or direction, and instead they take on the appearance of reality or simply a hypothetical situation. The message is not always intended or designed; at times it is unintentional. The transference of common knowledge can be transmitted via entertainment without explicit intent.

Entertainment programs provide a sensory input through which learning is made possible. In this case, information about mining activities and mines in general are conveyed whenever a mine becomes an element of a story in entertainment. These elements are presented as a matter of fact or common knowledge that reinforces negative stigmas held by the masses about mining. What the audience is watching is simply entertainment sought out for entertainment's sake. The viewer therefore is not on the defense for some sort of ulterior agenda (even though one is probably not present).

A search was conducted on the Internet Movie Data Base (IMDB) for any movies that had to do with the activity of mining to see how the miner, company, and practices are portrayed.

A mining community can take the role of a background setting in a story. For example, "October Sky" portrayed a West Virginian coal community during 1953 in which being a coal miner was the only option for young men looking for work (IMDB, 2010a). Coal mining was depicted as a grueling and dangerous line of work that offered no reward. This certainly may have been the case for certain communities during specific time periods, however movies like this reinforce a negative image of coal mining. These scenarios demonize the coal company by portraying them as paying next to nothing for expendable labor. Again, while this may have been true at one time, when this outdated content is applied to modern context misconceptions can be formed about modern mining, communities and jobs.

"North Country" depicted a semi-fictionalized account of a sexual harassment battle between women miners and a mining company (IMDB, 2010b). Due to the nature of the story, miner's actions were presented in a negative manner. The producers of this film had every right to tell this story, but when the depictions of miners are limited to a handful of movies, each one carries a lot of weight. It is no surprise what people think about mining when their views into the mines are so bleak.

A Disney holiday special "Prep and Landing" aired on ABC during the 2009 winter season and received excellent ratings (Nielsen Ratings, 2009). In one scene, an elf in charge of the naughty list interacts with a coal miner about the coal supply for the naughty children. The miner is depicted as a gnarly looking man with jagged teeth. This shows the social acceptability of depicting a certain population in a certain way. This blatant stereotyping goes without any voice of objection. This is particularly important considering children were the primary intended audience for this film.

Finally, the creator of the movie "*Super Size Me*" also created the series "30 Days". The series places producer Morgan Spurlock in a lifestyle that is completely different from his upbringing for thirty consecutive days (IMDB, 2010c). In the first episode from the third season, Spurlock becomes an underground coal miner for thirty days. During the course of the one-hour episode, Spurlock interviews individuals from

opposing sides of the coal mining debate. Although there was not enough time in a single episode to delve very deeply into both sides the episode does present both sides in a relatively objective and thought provoking way. It did not use the crutch of stereotypes when it depicted coal miners or the environmental activists alike. Although this series strays from being pure entertainment, as it is a documentary-style program, it is still marketed and aired as entertainment.

Mining is usually just a background setting or element in entertainment, but the elements that were once true for mining, such as low wage and physical dangers, are presented as common knowledge. While these elements may have been accurate for the time periods that are depicted, many such elements have been ameliorated in modern times. Misconceptions are created when the elements of past practices are applied to modern mining. The worst case scenarios are the ones most often employed and dramatized in entertainment. Miners themselves are victims of stereotyping that seems to be socially acceptable. This trend will probably not be reversed any time soon as TV and film producers live far from coal mining (e.g. New York, Los Angeles) and may rely upon what they believe they know about mines to produce entertainment.

3.1.3 Printed Books

Should an individual feel compelled to learn more about mining because of something they saw on the television or read on the internet they can seek out written material and books. Books provide an avenue for self-education and research, but is there a balanced selection of books on the topic of coal mining? Amazon.com was consulted to get an idea of what types of printed books are available on the topic of coal mining. Amazon was chosen because of its popularity and success at becoming the premier online market. A search was run for books using the key words "coal mining". The first ten books yielded from the search are presented in Table 3.2.

Table 3.2 Amazon.com Search Results for "Coal Mining" Books

	Title and Author	Genre
1	Growing Up in Coal Country by Susan Campbell Bartoletti	Historical Photo Essay
2	Coal Mining by G. Hayes	Textbook
3	Mining Economics and Strategy by Ian Runge	Textbook
4	Early Coal Mining in the Anthracite Region by John Stuart Richards	Historical Photo Essay
5	The Coal King's Slaves by William G. Williams	Historical Account
6	Big Coal: The Dirty Secret Behind America's Energy Future by Jeff Goodell	Sociological, Economic, Political Commentary
7	Introductory Mining Engineering by Howard L. Hartman and Jan M. Mutmansky	Textbook
8	Coal Mining by T. C. Cantrill	Textbook
9	Coal Geology by Larry Thomas	Textbook
10	Southern West Virginia Communities by Shirley Stewart Burns	Environmental Commentary

These results offer a few clues as to the types of knowledge sources people have at their disposal for self-education and research. Three of the books are historical in nature, including photo essays and personal accounts. Although these may have been accurate at one point in time they can be misleading if applied to modern context. For example, I have been asked on several occasions if I take a canary bird underground with me. A modern miner would know there are electronic monitoring devices that replaced the canary, however, since there are pictures of this historical practice it has become engrained in people's schema for the coal miner. As long as these historical accounts are taken as lessons in history, and not indicative of modern practices, then they can be quite useful for forming a holistic image of coal mining. Five of the ten books are collegiate level textbooks, and although full of very good technical information, they are not written to inform those outside of the technical field. As a result these books are probably overlooked by the average person seeking to be informed about coal mining, not engineering. These books have substantially higher prices and are most likely a deterrent as well. Finally, there are the commentaries written by professional journalists. These books cover the sociological, economical, political, and environmental effects of coal

mining. These are undoubtedly well researched works full of pertinent information and are probably the choice for somebody wishing to learn about the coal industry. These commentary books are however all anti-coal. The type of book that is devoid from the list is that which defends the merits of coal mining and provides an alternative stance to those presented in the books listed above. In fact, in the first 100 results of this search such a book could not be found. Although books are a very useful tool for exploring the research conducted by others about a subject, it is hard to consider their worth when only one side of the story is found. They are written by professionals whose jobs are to write. They are produced with specific aims in mind.

What is known about mining is a product of what is being taught about mining and actively portrayed though various media outlets. It is under the control of those who are doing the teaching. Not in classrooms but largely through medias' depiction of mining. This knowledge is not sought out but passed along as common knowledge. The popular image of coal mining is a product of medias' portrayal of what mining entails and is often out of date or biased against the industry. This socially acceptable stereotype is perpetuated by the framing of news stories and the way in which miners are depicted in entertainment.

Three media fronts from which people gain exposure to the portrayal of the coal mining industry were reviewed. These included news reporting, entertainment, and printed books. The majority of the stories that news media choose to cover tend to be negative in nature and place the coal mining industry in an antagonistic role. These stories are often about mining accidents or the negative environmental impacts. These stories are not the only stories that should be covered. The abundance of negative stories influences what is perceived to be normal for mining operations. It creates the common knowledge that all coal mining takes place in this manner. When coal mining or coal miners are presented as entertainment stereotypes, misconceptions are formed by those who take these elements and apply them to modern mining. These stereotypes are employed in entertainment for dramatic content, but miners themselves are victims of a stereotyping that seems to be socially acceptable. Those who are compelled to learn more about a topic can seek out books. While books are useful tools for exploring the in-depth research conducted on specific subjects, readers are hard pressed to find books

from both sides of the mining debate. Criticisms of coal mining are written by professionals who produced them with specific aims in mind. Miners and mining professionals are rarely authors to defend their profession or occupation because they are busy being miners and doing their jobs. Until the coal mining industry finds a stronger more positive position in major media outlets, the popular negative perception of mining will remain.

Without a detailed survey that polls the public about its knowledge of the mining industry, it is impossible to confidently state what it is that the public knows about the mining industry. The National Mining Association (NMA), which is a lobbyist organization that represents the mining industry in Washington D.C., conducts a survey every few years to poll such topics. The United States is broken into regions and the region polled alternates each time a survey is disseminated. Furthermore, given the expense of the survey and usefulness of the results, the NMA does not readily share the details of the survey until a few years have passed, and then only to member companies. A major outcome of the current study was the production of such a survey to better understand what the public, in three Kentucky counties, knows about the mining industry and their overall attitudes towards the industry.

3.2 What concerns people in regard to mining?

It is important to have an understanding of what the public knows about mining; especially if those beliefs are based upon misinformation and are outright inaccurate. This knowledge may not be the whole picture. What it is that causes people to be concerned with mining in general may be just as important. Before messages can be crafted it must be known what concerns people about mining, so that those issues can be directly addressed.

An educational message about what minerals are used for in everyday products may promote a sense of necessity for mining, but it may do little to shift negative feelings about mining. An image of mining being a "necessary evil" could be the result of such a message. Even when points of concern are addressed the language used is not always conducive to communication. For example, concerns for environmental impact are often countered with the amount of work that goes into reclamation efforts after mining. What

this then leads to is an explanation of what reclamation is, since the meaning of the word "reclamation" is often unknown amongst individuals outside of the industry.

This body of work sought to identify what aspects of mining are of the most concern to the public so that those concerns can be directly addressed. To do so, a survey contained questions about different areas of concern (environmental, economical, etc.) to determine which portions of the public have low attitudes towards them. Not every point of misinformation about mining or concern with mining can or should be addressed. It is important to highlight the largest knowledge gaps and lowest attitudes. Knowing what percentage of the public has similar concerns is critical for focusing efforts for the most efficient use of educational resources. The survey allowed for such information to be collected and quantified. This information will allow communications to be tailored to address specific concerns.

4.0 Literature Review

4.1 Relevant to the Mining Industry

The majority of what is found on this subject specific to the mining industry is simply rhetoric. Many call for the improvement of mining's image through the use of outreach and education programs (Dewey, 1982; Filas, 2001; Hautala, 1985; Kral, 2002; Spat, 2000; Urnovitz, 1991; Yernberg, 2006). These authors do little to explain how such efforts are supposed to be carried out. Current public relations campaigns on the behalf of individual companies or select sectors do exist. For example, coal has been at the forefront of recent notable efforts. Companies seek to improve their image, or the image of their sector. These efforts are often closely guarded from competition since that is the current nature of our market.

Urnovitz put it quite simply when he wrote, "If you always do what you've always done, you'll always get what you've always gotten." He argued that anti-mining groups have realized that the most compelling force that can be used against the industry is government and the regulations generated by the bureaucracy. Urnovitz saw a changing wind in the way mining was handled in politics and called for more education: first for the lawmakers and regulators, second the voters, and third, the youth still in primary education (Urnovitz, 1991). Educating the public with accurate information is the best way for the mining industry to defend against the accusations of critics (Jensen, 2000).

4.2 Caterpillar's Work

In 1991 Caterpillar Inc. produced an educational video entitled *Common Ground*, and since its debut has been reported to have been seen by 40 million people (Zimmerman, 2010). This twenty-six minute video was geared towards informing the viewer about the importance of mining while addressing topics of concern held by the public. While Caterpillar does not directly mine, they are a large provider of equipment and machinery to the mining industry; as a result they have a large stake in its wellbeing. Their philosophy was: "If we don't stand behind our customers then who will?" Identifying what people knew about mining was critical for narrowing the focus of

Common Ground, and this effort was lead by Nancy Bingham, who at that time worked for Caterpillar in the industry relations corporate mining group.

Bingham's formative research involved the use of personal interviews and focus groups in order to investigate what people knew about mining (Bingham, 1994). Although many of the more common ideas that people had about mining were reported, nothing has been published about the regions in which these focus groups were conducted or about the individuals in the groups. Audience targeting was deemed unnecessary as the video was intended for any person who was affected by and reliant upon mining, that is to say everyone. The idea was to determine the general knowledge about mining held by the public and address any knowledge gaps found.

Bingham found that there were four main concerns that dominated the public's perceptions about mining. These areas of concern are detailed below.

Environmental Harm- Those interviewed almost always voiced beliefs that mining will always have a negative and lasting toll on the environment. Mining was found to be synonymous with pollution, wasteland, and "ugly" strip mining operations. Distinction was rarely made between the various forms of surface mining; they were all lumped together as strip mining. When questioned about reclamation, very few were aware of the efforts, and when told about reclamation activities people were both enthusiastic and skeptical of the mining companies' willingness to follow through if it weren't mandated by law.

Human Harm- Members of the focus group often described images of communities with subpar living conditions where noise, air, and water pollution was prevalent. It seems as though the image of historical mining camps were still thought to be the norm. One notable quote was: "I think, too, the movie industry has really led us to believe that coal mining towns are depressing places to be."

Big Businesses' Exploitation of Workers- For those educated at the high school level, a common belief held was that miners were exploited by their employers. Those who were educated at the college level, beliefs were expressed in regard to of an unsafe working environment, especially when discussions shifted towards underground mining.

Little Personal Benefit- The notion that they were in no way affected by or reliant upon the mining industry was prevalent among the focus groups. They did not have any

knowledge as to how mining affects the general economy or how it provides the raw materials for virtually everything used in life.

Even though all of these beliefs had negative implications in attitude formation toward mining, they were identified and could be addressed in order to change attitudes. Bingham produced a belief structure held by individuals before any educational efforts. *Common Ground* was then centered on addressing these four areas. Bingham argued that because the public lacked the detailed knowledge to back up their negative beliefs, they were not strongly held. Therefore, the potential for shifting their attitudes was promising. Bingham further suggested that the main sources of information are movies and entertainment and that these sources are readily debased when a credible source provides alternative information. Movies and entertainment are two powerful forces that continue the secular trend of negative beliefs about mining (Viswanath, 2002). However, she does not provide any examples of credible sources. This suggests that the public has a wide latitude of acceptability for educational messages about mining given that they are well constructed (Atkin, 2001). Bingham's guidance for message construction is detailed later on in this dissertation. This potentially wide latitude is supported by a 2009 opinion poll conducted in Canada by Angus Reid. This survey was contracted by the Prospectors and Developers Association of Canada. They reported that 25% of the Canadian population is unconcerned about mineral extraction and an additional 36% were "Swing Voters" (PDAC, 2009). This combined 61% would constitute those who would be affected by an educational effort.

Pretesting of existing educational materials was conducted by Bingham by showing the materials to groups to evaluate their effectiveness at shifting beliefs by gaining qualitative feedback. The tapes included some older material produced by the United States Bureau of Mines and Homestake Mining Company as well as a six minute segment rough draft of *Common Ground*. A script was also presented for the entire *Common Ground* video.

Responses to the pretest material were monitored and classified into four categories: positive thoughts, negative thoughts, counter arguments, and extraneous thoughts. The pretest material was considered successful if it generated more positive than negative thoughts, and unsuccessful if counter arguments were generated

17

(suggesting a defensive stance was evoked) or extraneous thoughts (which would indicate an audience is not captivated). Gauging people's responses to the material allowed for the identification of effective materials and ineffective materials or those which generated counter arguments.

Suggestions for message creation were produced from these pretests and actual message content was recommended for rebutting each of the four main areas of concern. A product line of messages, detailed below, was suggested that ran counter to the beliefs held by people. Bingham, however, does not mention any theoretical backing for the message design.

Minimal Environmental Harm- To address concern for environmental harm Bingham suggested presenting facts about different mining techniques and how the land is altered. The efforts toward environmental monitoring carried out by experts should also be presented. Informing individuals about reclamation that takes place during and after mining accompanied by time lapsed images would be effective. While, it is important to include wildlife present on the reclaimed land, Bingham warns that excessive animals in quantity or variety can strain credibility. It would be important to instill a sense of the company willingly doing the right thing since a main criticism of this area is that the company is forced to reclaim the land by federal mandate.

Good for Community/Creates Jobs- The perception that humans are harmed by mining, whether it be local communities or individual miners, can be countered by bringing examples of mining communities and miners to light. Interviews are a good way to inform about the living conditions of those who actually live near mines. Information should be presented that highlight the quality of life as well as the lack of any negative elements that would be expected. Job creation is always important in any community, and highlighting these benefits along with the generation of tax dollars are important communication areas.

Good for Workers- Highlighting modern mining techniques and equipment and the safety they afford is important. Having actual miners give testimonials about job satisfaction, good salary, benefits, and pride from one's work add credibility by voicing the opinion of the miner, not the corporation.

Important in Daily Life- Facts about what minerals are in the products that are used on a daily basis go a long way in bringing home the necessity of mining. The shift must be made from mining is not needed to it is essential for modern life.

Highlight Small Companies- Involve examples of entrepreneurship in the mining industry. Highlight the "little guy" and small company owners in order to add a human aspect to the mining company's identity.

Many, though not all, negative beliefs were shifted through the educational materials tested. Investigating the preexisting beliefs and gauging the effectiveness of existing materials allowed for the generation of more useful communication techniques on the subject of mining. These were the foundations for *Common Ground*.

4.2.2 Common Ground

A VHS copy of *Common Ground* was viewed to see how the theory detailed above was put into practice in the final product (Caterpillar, 1991). The following are the ways in which each of the areas of concern from Bingham's work was addressed in the video.

Minimal Environmental Harm- Reclamation was defined after a few on-the-street interviewees said they had no idea what it is. The process was described and depicted through before and after images. The video points out how monitoring takes place by third party individuals. Wild animals were also featured in the footage.

Good for Community/Creates Jobs- A history professor was featured who talked about the stereotypes associated with coal mining towns, and that these are no longer true today. He discussed how images of the past should not be superimposed on the present. The planning phase for a new mine was exemplified through a California mine. Community meetings and the environmental planning process were shown. Representatives from the mine discussed the laws that were adhered to and the environmental monitoring that takes place before, during and after mining.

Good for Workers- Several testimonials were given by actual miners. They talked about how they liked their jobs, how they were not black-faced or covered in dirt, and the type of modern equipment they operated.

Important in Daily Life- This was a prevalent message that was mentioned several times throughout the video. Examples of several everyday products were given with the minerals they contained, such as televisions and walkmans.

Modern Mining- A segment of the video was devoted to discussing how modern mining takes place and how it has changed over the history of man. A history lesson was presented starting with the stone age, through the copper and bronze ages, and up to the iron and modern age. The video acknowledges how mining has not always been conducted correctly, but noted that things have changed over time. Underground mining was explained as well as the different types of surface mining. Reclamation was discussed again during this segment. Some time was devoted to explaining how minerals are formed in the earth over time and how they are discovered by geologists.

Recycling- An obvious effort was made to stress the finite nature of natural resources and the importance of conservation. Recycling was mentioned several times in an attempt to ally the image of mining to responsible efforts in order to shift the notion that mining stands counter to the idea of what would be identified today as the green movement.

The Little Guy- A small family-owned gold mining operation was highlighted, which presented the idea that not all mines are run by big corporations. The owner/miner discussed why he mines and how mining is simply a reaction to the market and consumption.

To transition between topics, "person on the street" interviews were placed intermittently. These also provided models that the audience could identify with. As a whole, the movie was quite jumpy and sporadic. Although it seemed to be full of good messages, no information could be found on any evaluations of the video itself. Where many of the areas of concern were addressed with an accurate rebuttal from the mining industry's side of the story, little is known if this end product was effective or even believable.

4.2.3 Ground Rules

In 2008, after nine months of production, Caterpillar released what they deemed to be the successor of the dated *Common Ground* video (Science North, 2008). The new video entitled *Ground Rules* had a higher production value and was produced by Science North. Science North is based out of Sudbury, Ontario and has expertise in "educational

and entertainment experiences" (Science North, 2010). A DVD of the video is made available to anyone who wants a copy at no charge. In addition to the video, seventy-five professionally developed lesson plans were produced for K-12 education. Caterpillar released a request to the mining companies it sold equipment to for stories about real mines that highlighted challenges of development, environmental considerations, community interaction, breaking new ground, and modern mines or miners. What resulted were the nominations of sixty mine sites around the world and a diverse set of unique circumstances. Of these sixty nominated sites, six sites were selected. These locations were in Chile, Indonesia, Canada, Ghana, Australia, and the United States (Zimmerman, 2010). *Ground Rules* is divided into eight chapters and each are discussed below.

Exploration- This chapter focuses on how new mineral deposits in New Guinea are found and mapped by geologists in the field. It follows a two-man team navigating the jungle floor, taking samples, and then studying those samples back in a lab.

Modern Mining- A state of the art mine in Chile, which supplies a large amount of the world's copper, is highlighted in this chapter. It features a female haul truck operator doing her job. The process of refining copper ore into a final product is described and shown.

Mining and the Modern World- In this chapter many household items are labeled with the minerals that are in them. A couple and their child are shown in their home doing everyday activities like playing videogames and barbequing. The man is later shown to be an actual underground miner in chapter five. The overt testimonials from *Common Ground* were replaced by a young family who lived in a very nice home with a man whom one would not suspect of being a miner, but is revealed later in the movie.

Engineering Challenges- Another mine in Indonesia was visited during this chapter. The engineering challenges of developing the required infrastructure at 14,000 feet and the development of local human resources are discussed. The local populations are vital for the success of the mine, and the chapter highlights the mine's commitment to ensuring the safety and wellbeing of the locals.

Going Underground- An underground mine in Sudbury is the center of this chapter where the audience was revealed to the fact that the man featured in chapter three is in

fact a miner at one of the deepest mines in the world. The mine has been in existence for over a century and has many more years ahead of it. The community exists because of the nickel that is mined below it. Though the community is mentioned, it is not shown. It seems as though a good opportunity was missed to show how mining towns are not what stereotypes deem them to be.

Mining and the Community- When Newmont wanted to open a gold mine in Ghana, it first had to obtain the social license to do so from the local populace. Mining would disrupt this community since it was predominantly dependent upon farming. In response to this local concern, training and education programs were instituted that taught the non-mining population trade and technical skills that would sustain the community long after the mining has been completed.

Mining and the Environment- In Northern Australia when a mine approached an existing river a decision was made to rechannel the river provided that it could be done in a responsible manner. The efforts of environmental experts working to ensure that the natural ecosystem and biodiversity was recreated in the new riverbed were highlighted. Environmental monitoring by the company, government, and non-government organizations were shown.

Reclamation- A coal mine in Wyoming is presented in this chapter while focusing on the reclamation efforts of the mine. The current concern about greenhouse gas emissions was also addressed in this chapter with new technologies, such as carbon capture and sequestration. Though this is good at disseminating the information that not all coal comes from the Appalachian region, it could attract criticism by not addressing coal mining in regions where it is more controversial.

The production value of *Ground Rules* is apparent and it has a documentary style. An important aspect of the video is the fact that no actors or extras were used and it was filmed on location. Many of the basic suggestions that came of Bingham's work were retained in *Ground Rules*. One observation is that while *Common Ground* was full of facts *Ground Rules,* seemed to forgo some fact for drama. It would be interesting to get feedback from audience members not associated with the mining industry about the video. When questioned about any criticism from viewers, Zimmerman could not recall

any. Again, no information was available about any evaluation process to determine how this video was received by audiences or if it had any effect on their opinions or beliefs.

4.3 The Mining Industry's Efforts

Debates, like the Coal Forum hosted by the University of Kentucky in November 2009, are good for those who are involved to get together and discuss solutions for the future, but those who come as part of the audience are likely individuals whose minds are most likely made up and unwavering, except (one would hope) for the press. These debates and forums are not effective tools for swaying general opinions but may offer advanced education opportunities for individuals who are willingly seeking it out (Atkin, 2001). This is a small portion of the population. One goal of this forum was to bring members from each side of the mining debate together in a round table setting in order to bring the extremes of the spectrum of opinions toward a mutual middle ground. It is argued that these individuals are not going to shift their stance. Social Judgment Theory (SJT) helps explain this with the use of the idea of latitudes of rejection, acceptance, and noncommitment (Sherif, 1963). This theory postulates that the more an individual has vested in an opinion the more they are shifted to the latitude of rejection, with the latitude of rejection being defensive against opinions contrary to their own. These members of the debate who have built their careers around either fighting for or against mining have a considerable amount of equity in their stances. As a result, this debate probably did little to bring these members of opposition towards any sort of middle ground.

Over the past quarter century the mining industry has had considerable improvement on many fronts, such as health and safety (Figures 4.1 and 4.2) and environmental impact; albeit some improvements have been in response to federal laws, such as the Surface Mining Control and Reclamation Act (SMCRA).

U.S. Mining Fatalities CY 1978 - 2009
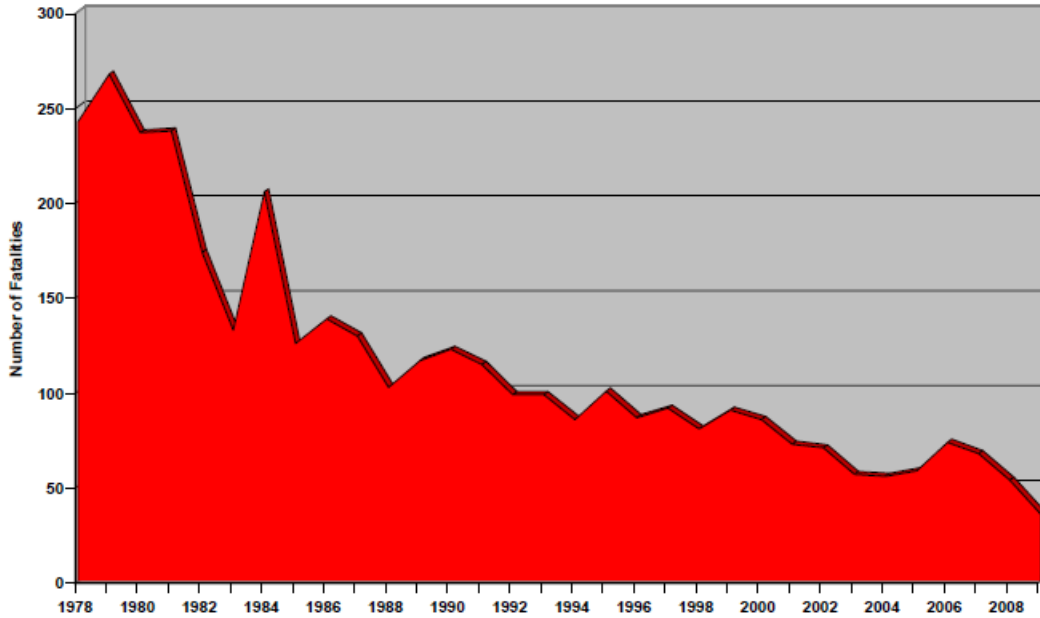
Figure 4.1 Mining Fatalities 1978-2009 (MSHA,2009)

U.S. Mining Record of Reduction
Total Injury Rate, 1990-2009
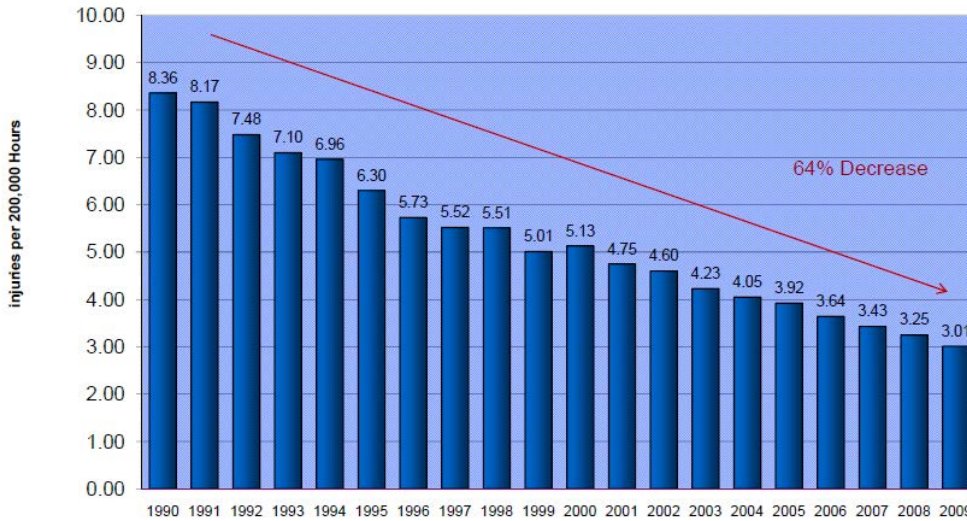
Figure 4.2 Mining Injury Rate 1980-2009 (MSHA, 2009)

Despite these marked improvements for human health and wellbeing there is still an air of negativity that surrounds mining's image. This has been explored in previous sections. It is important that the industry as a whole attempts to make changes in how it

communicates its improvement and self-betterment. It is not enough to win awards for reclamation if nobody knows about them.

4.4 Theoretical Foundations

4.4.1 Social Judgment Theory

Social Judgment Theory (SJT) is a persuasion theory founded by the work of Muzafer Sherif and Carl Hovland. The theory states that individuals have categories of judgment which are used to evaluate messages. These categories, known as latitudes, are the latitude of acceptance, latitude of non-commitment, and latitude of rejection. The latitude of acceptance is comprised of the range of positions that are accepted as true or agreeable by an individual. The center of this latitude is anchored by an individual's personal attitude on a subject. The latitude of non-commitment contains positions that are neither accepted nor rejected. The latitude of rejection holds the positions that are rejected or considered false by an individual (Figure 4.3) (Sherif & Hovland 1961).
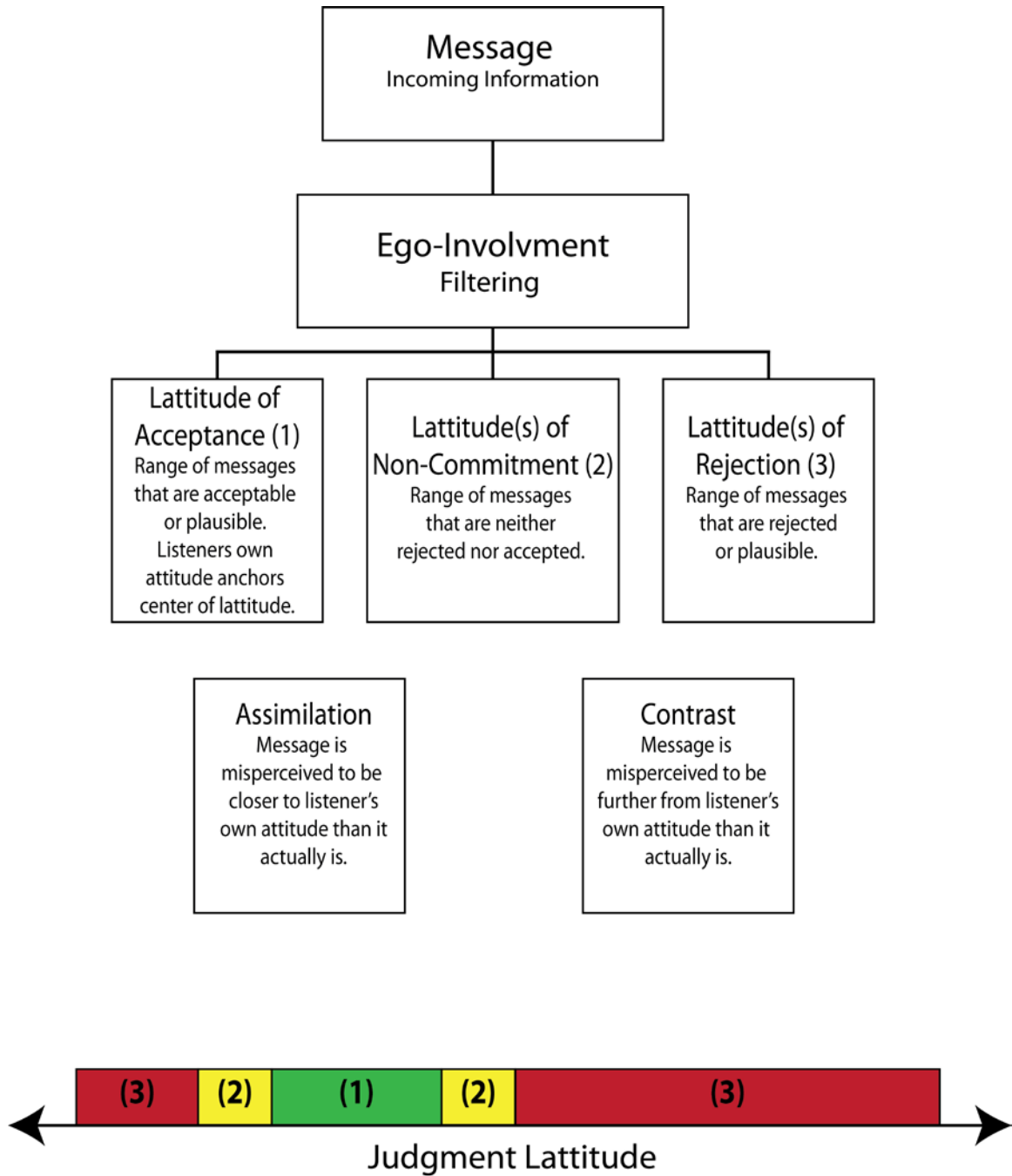
Figure 4.3 Social Judgment Theory (Sherif & Hovland, 1961)

When messages are received an individual places it in these categories of judgment. This process of passing judgment on a message or position happens quickly and often without conscious thought toward the judgment process. Persuasion has the best chance of success when a message falls within an individual's latitude of acceptance.

The theory also stresses the importance of "ego-involvement" and how it can affect the range of an individual's particular latitudes. Ego-involvement refers to the level that a position relates to an individual's self-identity (Johnson & Eagly, 1989). For example, a miner will have a large latitude of acceptance for positions that support mining and its positive benefits and a small latitude of acceptance for positions that are critical of the mining industry. Contrariwise, a person who has a strong involvement with activist groups that protest the mining industry will have a large latitude of acceptance for positions that are critical of the mining industry and a small latitude of acceptance for positions that support mining and its positive benefits. This topic is important for messages about mining and audience targeting and will be further discussed in later chapters.

The concept of subjective distortion is also mentioned in SJT. Individuals will distort messages to either interpret them as closer or further from their anchor point, than the messages really are. These distortions are called assimilation and contrast, respectively. Assimilation is the result when the message falls within the latitude of acceptance, close to the anchor point, and the individual interprets it as something they already agree with. The message is pulled closer to the anchor point than it really is instead of the individual's anchor point being pulled towards the message. This results in no persuasion being made. Contrast on the other hand is when the message falls outside the latitude of acceptance, and the individual interprets it as further from their position than it really is. The message is pushed into the latitude of rejection. Again, this too results in no persuasion. (Sherif, Sherif & Nebergall, 1965).

For persuasion to take place the message must land within an individual's latitude of acceptance; it must be different than their anchor point, and neither assimilation nor contrast can occur. Persuasion by these rules is a difficult, slow and gradual process. Also, given the difficulties that come about from ego-involvement, those with high ego-involvement are not prime targets for messages tailored within this framework. This is a good theory for educating the general public about mining, however, for those with vested interest either for or against mining another theoretical framework is proposed and discussed in the next section (Sherif & Sherif, 1967).

4.4.2 Maslow's Hierarchy of Human Needs

Since individuals with high ego-involvement with a subject have large latitudes, persuasion is thought to be harder. For reaching those individuals a theory of human motivation is proposed. One theory of human motivation as championed by Abraham Maslow is based on his hierarchy of human needs. Maslow's hierarchy of needs consists of five areas. These areas of needs are (in order of propensity) physiological, safety, love/belonging (social), esteem, and self-actualization. This hierarchy can be visualized in the form of a pyramid (Figure 4.4). The base of the hierarchy consists of the most important physiological needs. These needs include the basics for maintaining life such as breathing, food, water, sex, sleep, homeostasis, and excretion. If these basic needs are not met it is unlikely for a person to be considered with needs further up the hierarchy. The next tier contains the need for safety, be it personal, employment, belongings, health, or family. Above that is the need for love or belonging in the form of family, friends, and intimacy. These are social needs. Next is the need for esteem. This is manifested in self-esteem, achievements, and mutual respect for other individuals. At the top of the hierarchy is the need for self-actualization (Maslow, 1943). Basically this can be referred to as fulfilling a purpose or realizing one's potential.

Maslow theorized that human motivation is systemic of securing these needs. It is important to note that this is not a behavior theory that explains human action, but only a variable (albeit a large variable) in the behavior process, whether it be conscious or unconscious. Human needs require fulfillment in order of priority from the bottom of the hierarchy up. This can be illustrated in a situation where an individual is destitute of all aforementioned needs. That individual will be driven to obtaining water, food, and homeostasis before they would concern themselves with other needs. Once the needs of one level are fulfilled, the priorities shift toward the next set in the hierarchy. This however is not a stepwise function. That is to say 100% satisfaction of one level is not required before an individual begins to cognize their want for the next set of needs. Consider the individual who has 90% of their physiological needs met. For that individual, attention has probably shifted towards thoughts concerning safety. Needs further up the hierarchy have a decreasing likelihood of being internalized as important, and as needs on the lower tiers are satisfied, if only partially, higher needs increase in

probability of being a priority. Overall, the prioritization of needs will progress from the bottom of the hierarchy upward. This leads to an ever shifting set of priorities by individuals and a constant state of "want" or drive. This want creates a human condition of "incentivization of action." For example, eating has the incentive of relieving the pang of hunger.
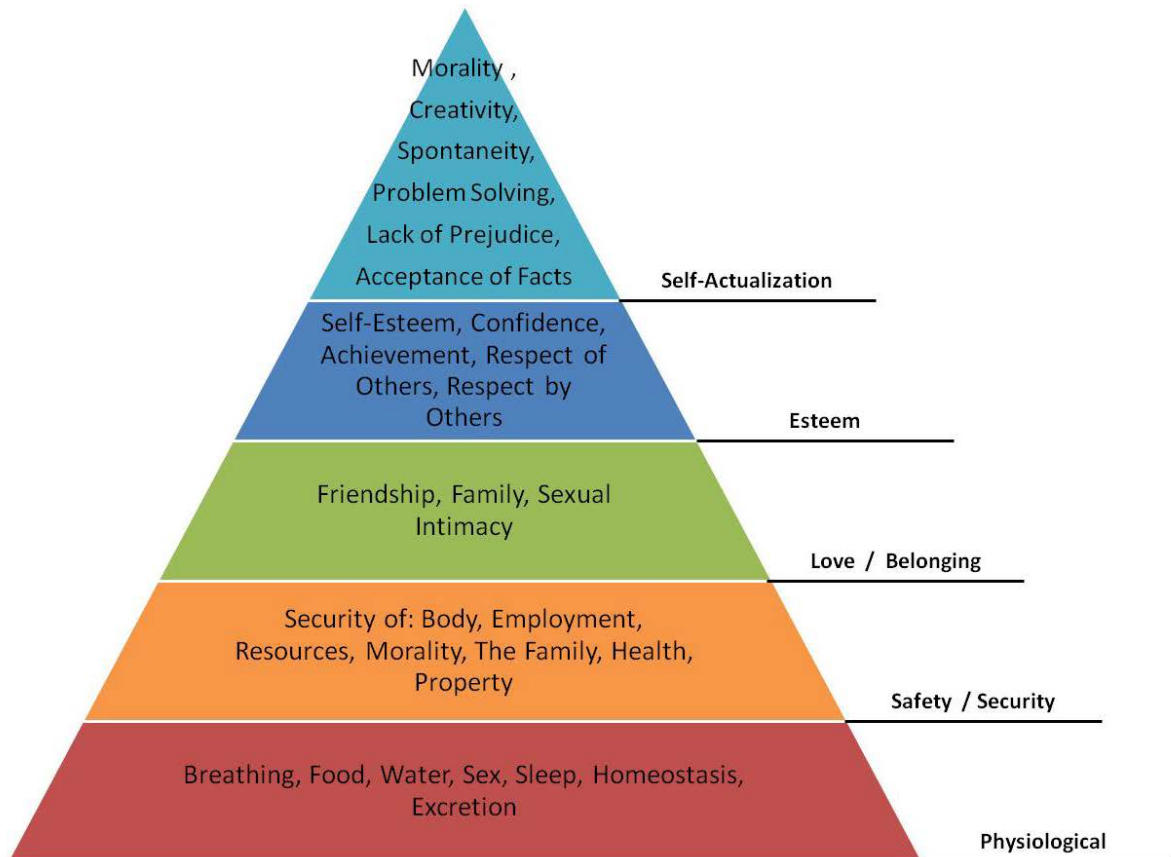
Figure 4.4 Maslow's Hierarchy of Human Needs

Maslow's hierarchy was conceived from the vantage point of a culture that praises individualism. Not all cultures value the individual above the collective. In these communal cultures some priorities may be in different order. In this case, perhaps a desire to be accepted by the collective is held above some degrees of safety. Studying how appeals are made to these needs at the level that is appropriate for an individual (or community for that matter) can lead to insights as to how incentivization of stakeholder

support can be classically explained. To illustrate this subsequent sections will show examples of how real mining operations have engaged in actions that affect the communities in which they are involved and how Maslow's framework can be applied to and explain each activity.

4.4.3 Survey Design

Much work has been conducted in the field of survey design. This area will be reviewed more thoroughly during the actual survey design. Many sources exist which guide this process (Aaker, 1998; Bradburn, 2004; Dillman, 2000; Knowles, 1975; Zikmunk, 2003). These authors raise the following concerns:

- Succinct Questions
- Simple Language
- Accurate Spelling/Grammar
- Avoid Leading/Loaded Questions
- Be Specific and Avoid terms like "often" or "regularly"
- Address One Issue at a Time
- All Possibilities included in Responses
- Start with Non-threatening Questions
- End with Sensitive Questions
- Group Questions by Topic
- Logically Place questions so respondents can follow along easily

These sources were invaluable for addressing each of these concerns in the design of the survey.

A telephone survey was used to collect data about the public's attitudes and knowledge of mining. Its proper design and implementation was critical for the collection of worthwhile data. Surveys help us learn what groups of individuals believe and do. Surveys are useful for asking respondents, and the populations they represent, about their beliefs, attitudes, and behaviors (Frey, 2000). This survey can help guide educational efforts by identifying any widespread attitudes and knowledge gaps that could influence negative opinions about mining.

Angus Reid, a Canadian based public opinion polling firm, recently conducted a nationwide survey in Canada on the topic of the mineral sector. The poll was funded by the Prospectors & Developers Association of Canada (PDAC, 2009). The Angus Reid survey was reviewed and it helped guide the design of the survey used in this study. Bingham's work was also instrumental in guiding the design of the survey used in this study.

A survey was designed to answer the following research questions:

- What are the attitudes about mining and knowledge of mining of the surveyed sample?
- Can knowledge be predicted from demographic information?
- Are there differences in attitudes among different demographic variables?
- Is there a relationship between an individual's self report of knowledge about mining and their tested knowledge about mining?
- Is there a relationship between tested knowledge about mining and attitudes toward mining?
- What are the actions that the public takes that can affect mining, and how can those actions be explained with the metrics of attitudes and knowledge?
- What can be done to improve the perceptions the public has about mining?

To answer these questions, this survey was designed in four complementary components: Demographics, Attitudes about Mining, Knowledge of Mining, and Actions with relations to mining. Five areas of concern were chosen to guide the selection of individual questions within the attitudes and knowledge components. The four areas found in Bingham's work were used to guide area selections, and one additional area was added. Each area had complementary attitude and knowledge questions within the survey. The five areas of concern were Environmental Concerns, Business Practices, Personal Benefit, Human (Public) Concerns, and Economic Concerns. A full survey can be found in Appendix A.

The purpose of the survey was to determine what the public in three Kentucky counties knows about mining and their attitudes towards mining. With this knowledge,

educational materials that address these knowledge gaps or concerns can be selected from the wealth of material that is available and ready to be tested for effectiveness in changing attitudes toward mining. If new areas of public knowledge or concern are found then a redesigning of educational communications can be conducted.

4.4.4 Likert Scale

The Likert scale is a psychometric scale named after its creator, Rensis Likert. A Likert scale is a collective of several Likert items (8+), which ask a respondent to state their level of agreement or disagreement with a statement. A typical five-level Likert item could contain the following response levels to a statement (Likert, 1932):

1. Strongly disagree
2. Somewhat Disagree
3. Neither Agree nor disagree
4. Somewhat Agree
5. Strongly Agree

At times an even number of responses are provided where the neutral point is removed; this is referred to as a forced choice method (Allen, & Seaman, 2007). The Likert scale is then generated from the sum of the values assigned to each of the Likert item responses. The resulting value on a range of possible values is analogous to an individual's overall attitude or opinion towards a given subject common amongst all the Likert items (Burns & Burns, 2008). Analysis of the results can be performed on the individual Likert items or on the summed Likert scale.

4.4.5 Statistical Tests

Non-parametric statistical tests are used when data do not meet the assumptions that would define them as parametric. Assumptions for parametric data are: 1) data are normally distributed, 2) variance is homogenous, 3) data are interval, and 4) observations are independent from one another. Since, data collected from a survey that uses Likert scales to measure subjective responses are not as controlled or clean as the type of data collected in labs they often do not meet these assumptions. As a result, this limits the types of statistical tests that are appropriate and accurate for analysis. If parametric

assumptions are not met, non-parametric tests can be considered for use, provided the assumptions associated with them are met (Field, 2009). The following are the statistical tests that are used with the data collected from the survey to answer the aforementioned research questions.

Kruskal - Wallis Test

The Kruskal-Wallis test is a nonparametric test used to analyze differences between two groups. The following assumptions must be met in order to utilize the Kruskal-Wallis test in an appropriate and accurate manner: (1) scores on the dependent variable are ranked, (2) the independent variable is between-subjects in nature, and (3) the independent variable is categorical and has at least three levels (Jaccard and Becker, 2002). It is calculated using Equation 4.1. Statistical significance is determined when p is less than 0.05. The p-value is the probability of obtaining a test statistic at least as extreme as the actually observed. A p-value level of 0.05 is the common standard in statistical analysis to determine statistical significance. This means that there is a 95% probability that the results are indeed significant with only a 5% chance of these results occurring randomly.

$$H = \frac{12}{N(N-1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(N+1)$$

[4.1]

Where:

R_i = Sum of ranks for each group

N = Total sample size

n_i = Sample size for a particular group

The Kruskal-Wallis tests only identifies when samples are different from one another. When differences were confirmed and more than two samples were present, *post hoc* Mann-Whitney tests were performed to determine where the differences occurred.

Mann-Whitney Test

The Mann-Whitney test is a non-parametric statistical test for determining if two samples significantly differ from one another. This test is appropriate when: (1) both

group's observations are independent from each other, and (2) the data is ordinal. This test is performed using Equation 4.2 (Jaccard and Becker, 2002).

$$U = n_1 n_2 + \frac{N_1(N_1 + 1)}{2} - R_1$$

[4.2]

Where:

n_i = Sample size for each group

N = Total sample size

R_1 = Sum of ranks for group 1

However, if multiple Mann-Whitney tests are used on the same data analysis, Type 1 error rate is inflated, or the likelihood to indicate a test is statistically significant when in fact it is not. In order to prevent Type 1 errors a Bonferroni correction was used. With a Bonferroni correction statistical significance is determined by dividing the standard p-value of 0.05 by the number of tests that were conducted. This value is then used as the new criterion for determining statistical significance.

Spearman's Correlation Coefficient

Spearman's Correlation Coefficient is a non-parametric test for measuring the strength of association or relationship between two ranked or ordinal variables. The assumptions for this test are (1) scores on both variables are rank form, (2) both variables have been measured on the same individual, and (3) observations for each variable are between-subjects in nature (Jaccard and Becker, 2002). Calculating the Spearman's Correlation Coefficient is done using Equation 4.3.

$$r_s = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{(N - 1)s_x s_y}$$

[4.3]

Where:

r_s = Spearman's Correlation Coeffecient

s_x = Standard Deviation of first variable

s_y = Standard Deviation of second variable

N = Total of observations

x_i = Observation in question from first variable

y_i = Observation in question from second variable

$$\bar{x} = Mean\ of\ first\ sample$$

$$\bar{y} = Mean\ of\ second\ sample$$

Multiple Linear Regression

Multiple regression is utilized to study whether specific variables can predict an outcome. It builds a model based on the dataset to predict a specific outcome. Multiple regression can be used with categorical predictor variables as well. The basic multiple regression equation is below (Equation 4.4):

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ ... \ \beta_i x_i + \varepsilon$$

[4.4]

where:

y = outcome variable

β_i = predictor coefficients

β_0 = y intercept

x_i = predictor variables

ε = Error between predicted and observed value of y for the ith participant

The assumptions for this test are: 1) predictor variables are quantitative or categorical, and the outcome variable is quantitative, continuous and unbounded, 2) predictor variables have variances other than zero, 3) predictor variables are not multicollinear, 4) predictor variables are homoscedastic, 5) residual terms should be uncorrelated between any two observations, 6) errors are normally distributed, 7) values of the outcome variable are independent, and 8) the relationship being modeled is linear (Field, 2009).

4.4.6 Statistical Tests and Research Questions

The research questions posed by this study that can be answered using statistical analysis are listed below followed by the statistical tests that will be used to answer them:

- Can knowledge be predicted from demographic information? (Multiple Linear Regression)
- Are there differences in attitudes among different demographic variables? (Kruskal-Wallis Test and Mann-Whitney Tests)

- Is there a relationship between an individual's self report of knowledge about mining and their tested knowledge about mining? (Spearman's Correlation Coefficient)
- Is there a relationship between tested knowledge about mining and attitudes toward mining? (Spearman's Correlation Coefficient)
- What are the actions that the public takes that can affect mining, and how can those actions be explained with the metrics of attitudes and knowledge? (Kruskal-Wallis Test and Mann-Whitney Tests)

5.0 Survey Results, Discussion, and Applications

The telephone survey of Harlan, Johnson and Lincoln County residents was conducted by the University of Kentucky Survey Research Center. Households were selected using a modified list-assisted Waksberg-Mitofsky random-digit dialing procedure, which ensures every residential telephone line in these Kentucky counties had an equal probability of being called. Calls were made from December 20, 2012 – January 22, 2013. Up to 15 attempts were made to each number in the sample. In addition, up to ten scheduled call-backs were made to those we reached at an inconvenient time, and one refusal conversion was attempted. The total sample size among all three counties was 317 with approximately 100 from each county.

The results and conclusions from the statistical methods employed to answer the questions raised in the Rationale section using the data collected from the surveys are discussed in this chapter.

5.1 Survey Questions

Recall that the survey was designed in four complementary components: Demographics, Attitudes about Mining, Knowledge of Mining and, Actions with relations to mining. This section discusses each of these components in detail.

5.1.1 Demographics

The survey contained demographic questions of age, gender, ethnicity, political party affiliation, education, and household income (Appendix A).

5.1.2 Attitudes of Mining

The survey contained seventeen 4-Point Likert Scale questions to survey attitudes about mining. These attitude questions put forth a statement that could be made about mining and asked the respondent to state how much they did or did not agree with the statement (Table 5.1). The response options were Strongly Disagree, Somewhat Disagree, Somewhat Agree, Strongly Agree, and Don't Know. It was also noted when respondents refused to answer. The four point scale was intentionally chosen to remove the opportunity for a respondent to hold a neutral position on the statements. Attitude questions were asked from the five areas of concern. These questions included positive

statements towards mining and negative statements toward mining to reduce any Confirmation and Consistency bias. The "+", and "-" symbols demarcate positive mining and negative mining statements (Table 5.1). The order in which these questions were asked was randomized from survey to survey to remove any order bias.

5.1.3 Knowledge about Mining

The survey also contained fifteen questions which tested the participants knowledge of mining practices, benefits, and impacts (Table 5.1). These knowledge questions were in the form of multiple choice and true/false answers. These questions were grouped together based on the mode of responses during the administration of the survey. The order in which they were asked and the order of the answers were randomized within the grouping to remove any order bias. Questions were asked from each of the five areas of concern.

Table 5.1 Attitude and Knowledge Questions Grouped by Area of Concern

Attitude Statements	Knowledge Questions
Environmental Concerns	
The mining process includes cleaning up after mining is done. (+)	Reclamation is defined as:
Mining does not affect that much land. (+)	What percentage of land has mining disturbed in America?
Mining companies are not environmentally conscientious. (-)	Mining companies take environmental impact into account when planning a mine.
Mining is permanently damaging to the environment. (-)	After mining is done the land is restored.
Business Practices	
Mining companies are bad companies to work for. (-)	How much does the average miner earn each year?
It is safe to be a miner. (+)	Of these four professions which do you think is the most dangerous?
Mining is a thing of the past. (-)	How many more years can mining continue in the United States?
Mining uses up to date technology. (+)	Canaries are still used to test the air in mines.
Economical Concerns	
Mining is important in many states in the United States. (+)	How many states have mines?
Mining is not important to the US economy. (-)	What percentage of the US Gross Domestic Product is mining responsible for?
Mining creates a lot of good jobs. (+)	How many miners are in the US?
Personal Benefit	
Products of mining are used to make almost everything I use on a day-to-day basis. (+)	How many pounds of mined material does the average American use every year?
America would be worse off without mining. (+)	What is the number one source of electricity in the US?
Mining does not contribute significantly to Americans standard of living. (-)	You use the products of mining on a day to day basis.
Mining is important to me. (+)	
Human (Public) Concerns	
Communities around mines are good places to live. (+)	Mining companies have complete control where mines can be.
Mining is acceptable as long as it is carried out far from where people live. (-)	

An additional question was also posed with a Likert-style question to measure how much respondents thought they knew about mining. This was stated as such: "How much would you say you know about mining in the US, overall?" The response options were: No Knowledge, Very Little Knowledge, Some Knowledge, A good Deal of Knowledge, or Don't Know. It was also noted if the respondent refused to answer.

5.1.4 Actions

A portion of the survey contained questions about actions the respondent might have taken that impact the mining industry (Table 5.2). If an individual responded yes to any of the action questions, a follow up question was asked to determine if the action was taken in the past five years or greater than five years ago.

Table 5.2 Action Questions

Have you ever made a formal complaint against a mining company?
Have you ever voted for a political candidate because of their pro-mining position?
Have you ever voted for a political candidate because of their anti-mining position?
Have you ever attended a pro-mining rally?
Have you ever attended an anti-mining rally?

4.2 Surveyed Populations

A survey was administered in three Kentucky counties to determine what the Kentucky publics' attitudes and knowledge about the different aspects of the mining process. The three Kentucky counties that were selected for the survey were Harlan, Johnson, and Lincoln counties. Primarily this selection was made with the intention of having a high coal producing county, a medium coal producing county and a no coal producing county. Out of the 30 coal producing counties Harlan county ranked in 2nd for number of mines (63 mines) and 4th in total coal production (10,441,000 tons) in 2009 in Kentucky. Johnson county ranked 14th for number of mines (9 mines) and 16th for total production (2,309,000 tons) in 2009 (USDOE Annual Coal Report 2009) (Figures 5.1 and 5.2). Lincoln was adjacent to counties with historical coal mining activity. Figures 5.1 and 5.2 present the ranks of the counties by production and number of mines respectively. United States Census data was utilized to keep relatively constant other factors, such as no major urban centers, poverty rate, education level, and median household income (USCB-ACS 2009-2011).
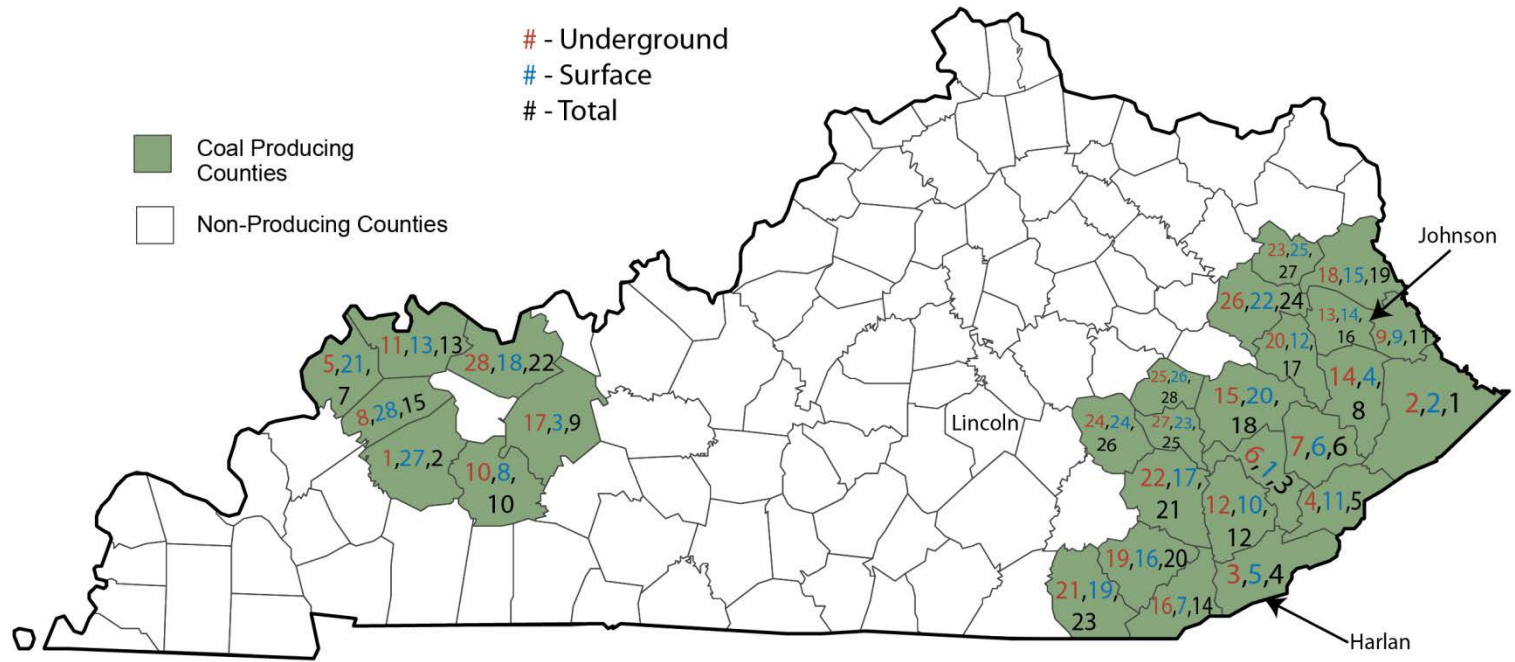
Figure 5.1 Kentucky Counties Ranked by Coal Production

- Underground
- Surface
- Total

East Kentucky Producing Counties

Non-Producing Counties

23,19, 22

17,8,10

Johnson

26,23,26

16,10, 14

6,15 8

18,9 12

5,5,5

19,25,23

1,1,1

11,27, 21

28,24,27

25,22, 25

12,17, 16

4,6,4

21,28,28

24,21, 24

27,18, 19

8,3,6

20,20,20

Lincoln

22,13, 17

9,14,9

3,7,3

10,26, 18

15,12, 13

13,11,11

2,2,2

14,16, 15

7,4,7

Harlan
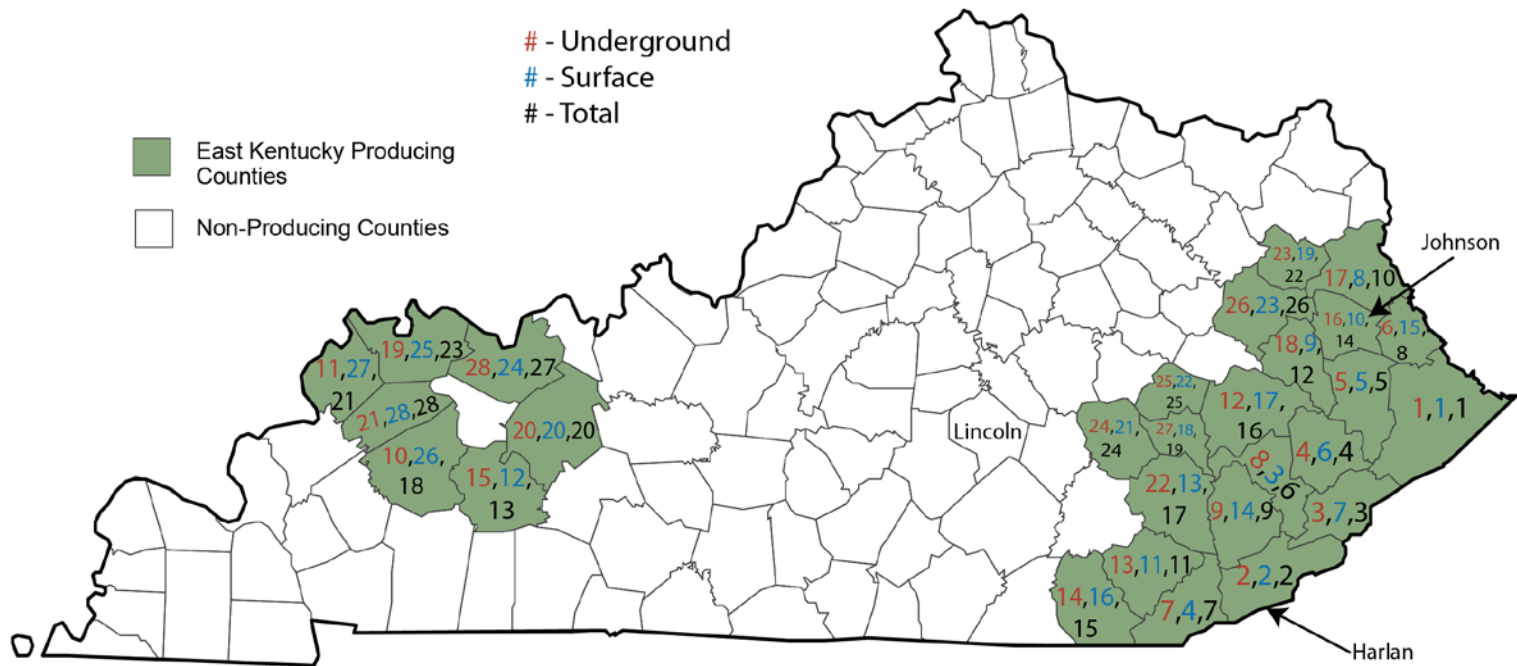
Figure 5.2 Kentucky Counties Ranked by Number of Mines

The demographic information collected from the respondents contained their age (Table 5.3), gender (Table 5.4), political affiliation (Table 5.5), education (Table 5.6), household income (Table 5.7), and race/ethnicity (Table 5.8). This information from the surveyed population has been reported for each county and for all three counties (Tables 5.3 to 5.8).

Table 5.3 Age Distribution of Survey Respondents

Age								
County of Residence	18-27	28-37	38-47	48-57	58-67	68-77	78-87	88-97
Harlan	7.0%	13.0%	15.0%	31.0%	20.0%	10.0%	4.0%	0.0%
Johnson	4.7%	7.5%	15.0%	27.1%	34.6%	9.3%	1.9%	0.0%
Lincoln	2.8%	1.9%	13.0%	25.0%	25.0%	20.4%	10.2%	1.9%
All Three	4.8%	7.3%	14.3%	27.6%	26.7%	13.3%	5.4%	.6%

Table 5.4 Gender Distribution of Survey Respondents

Gender		
County of Residence	Male	Female
Harlan	43.6%	56.4%
Johnson	46.7%	53.3%
Lincoln	40.4%	59.6%
All Three	43.5%	56.5%

Table 5.5 Political Affiliation of Survey Respondents

Political Party								
County of Residence	Democrat	Indep. Leaning Democrat	Independent	Indep. Leaning Republican	Republican	Other	Don't Know	Refused
Harlan	49.5%	2.0%	7.9%	2.0%	34.7%	1.0%	2.0%	1.0%
Johnson	37.4%	0.0%	3.7%	1.9%	50.5%	1.9%	2.8%	1.9%
Lincoln	40.4%	1.8%	3.7%	4.6%	42.2%	1.8%	3.7%	1.8%
All Three	42.3%	1.3%	5.0%	2.8%	42.6%	1.6%	2.8%	1.6%

Table 5.6 Education Level of Survey Respondents

	Last Grade Completed in School								
County of Residence	Grade School Only	Some High School	High School or GED	Associates	Bachelors Degree	Masters	PhD	Don't Know	Refused
Harlan	5.9%	12.9%	36.6%	22.8%	11.9%	9.9%	0.0%	0.0%	0.0%
Johnson	4.7%	6.5%	49.5%	15.0%	15.0%	7.5%	0.0%	.9%	.9%
Lincoln	4.6%	11.9%	60.6%	9.2%	9.2%	3.7%	.9%	0.0%	0.0%
All Three	5.0%	10.4%	49.2%	15.5%	12.0%	6.9%	.3%	.3%	.3%

Table 5.7 Household Income Distribution of Survey Respondents

	Total Household Income Before Taxes - 2012							
County of Residence	Under $7,500	$7,500-$12,500	$10-$12,500	$12,500-$15,000	$15,000-$20,000	$20-$25,000	$25-$30,000	$30-$40,000
Harlan	4.0%	3.0%	1.0%	2.0%	0.0%	7.9%	5.9%	6.9%
Johnson	1.9%	.9%	3.7%	1.9%	5.6%	6.5%	0.0%	13.1%
Lincoln	3.7%	1.8%	4.6%	4.6%	1.8%	11.0%	.9%	11.9%
All Three	3.2%	1.9%	3.2%	2.8%	2.5%	8.5%	2.2%	10.7%

	$40-$50,000	$50-$70,000	$70-$90,000	$90-$120,000	Over $120,000	Don't Know	Refused	
Harlan	9.9%	13.9%	8.9%	6.9%	4.0%	16.8%	8.9%	
Johnson	4.7%	13.1%	6.5%	11.2%	8.4%	14.0%	8.4%	
Lincoln	7.3%	7.3%	6.4%	2.8%	4.6%	22.0%	9.2%	
All Three	7.3%	11.4%	7.3%	6.9%	5.7%	17.7%	8.8%	

Table 5.8 Ethnicity Survey Respondents

	Race - Ethnicity				
County of Residence	White	African American	American Indian, Eskimo, or Aleut	Asian or Pacific Islander	Some other race
Harlan	95.0%	2.0%	3.0%	0.0%	0.0%
Johnson	98.1%	0.0%	.9%	.9%	0.0%
Lincoln	96.3%	2.8%	.0%	0.0%	.9%
All Three	96.5%	1.6%	1.3%	.3%	.3%

5.3 Initial Survey Results

The information provided in Tables 5.9 through 5.13 outlines respondents' attitudes about the statements that could be said about mining and are segregated by county. Each table contains the questions within one of the five areas concern. Recall that questions were worded both positively and negatively toward mining. When respondents strongly agreed or somewhat agreed with a positive statement they could be considered to have positive attitudes towards the statement. When they strongly disagreed or somewhat disagreed with a positive statement they could be considered to hold negative attitudes about the statement. The converse can be held true about the negative questions.

Table 5.9 Attitude Questions over Environmental Concerns, Segregated by County

Environmental Concerns	**Mining companies are not environmentally conscientious.**			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	53.7%	14.7%	16.8%	14.7%
		Johnson		41.0%	29.0%	20.0%	10.0%
		Lincoln		24.0%	41.0%	22.0%	13.0%
	The mining process includes cleaning up after mining is done.			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	3.0%	2.0%	10.1%	84.8%
		Johnson		1.0%	1.9%	14.3%	82.9%
		Lincoln		3.8%	3.8%	26.0%	66.3%
	Mining does not affect that much land.			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	22.7%	17.5%	23.7%	36.1%
		Johnson		9.9%	30.7%	26.7%	32.7%
		Lincoln		24.2%	26.3%	34.7%	14.7%
	Mining is permanently damaging to the environment.			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	52.5%	22.2%	13.1%	12.1%
		Johnson		52.8%	29.2%	10.4%	7.5%
		Lincoln		29.8%	35.6%	24.0%	10.6%

It can be seen in Table 5.9 that attitudes about environmental concerns regarding mining are most positive in the county with the most coal mining and least positive in the county with no coal mining. As the amount of coal mining increases so do positive attitudes about environmental aspects of mining.

Table 5.10 Attitude Questions over Business Practices, Segregated by County

	Mining companies are bad companies to work for.		Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
Business Practices	County of Residence	Harlan	61.2%	20.4%	13.3%	5.1%
		Johnson	65.1%	25.5%	4.7%	4.7%
		Lincoln	40.0%	41.1%	15.8%	3.2%
	It is safe to be a miner.		Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	10.4%	9.4%	35.4%	44.8%
		Johnson	6.9%	20.6%	35.3%	37.3%
		Lincoln	27.7%	25.7%	36.6%	9.9%
	Mining uses up to date technology.		Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	2.0%	3.0%	20.2%	74.7%
		Johnson	0.0%	4.0%	26.7%	69.3%
		Lincoln	5.1%	10.1%	59.6%	25.3%
	Mining is a thing of the past.		Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	74.3%	11.9%	10.9%	3.0%
		Johnson	72.4%	15.2%	10.5%	1.9%
		Lincoln	58.9%	28.0%	10.3%	2.8%

The % within County of Residence label applies to each County of Residence block.

It can be seen in Table 5.10 that attitudes about business practices of mining companies are most positive in the county with the most coal mining (with the exception of the first question in Table 5.10) and least positive in the county with no coal mining. As the amount of coal mining increases so do positive attitudes toward the business practices of mining companies

Table 5.11 Attitude Questions over Personal Benefit, Segregated by County

			Mining does not contribute significantly to Americans standard of living.	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
Personal Benefit	**Mining does not contribute significantly to Americans standard of living.**			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	74.0%	14.0%	6.0%	6.0%
		Johnson		78.1%	14.3%	1.9%	5.7%
		Lincoln		58.7%	23.1%	10.6%	7.7%
	Products of mining are used to make almost everything I use on a day-to-day basis.			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	2.1%	12.4%	22.7%	62.9%
		Johnson		4.8%	10.6%	25.0%	59.6%
		Lincoln		10.4%	15.6%	45.8%	28.1%
	America would be worse off without mining.			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	16.8%	5.0%	6.9%	71.3%
		Johnson		10.3%	.9%	14.0%	74.8%
		Lincoln		9.3%	13.9%	17.6%	59.3%
	Mining is important to me.			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	3.0%	2.0%	8.0%	87.0%
		Johnson		1.9%	.9%	10.4%	86.8%
		Lincoln		7.4%	11.1%	33.3%	48.1%

When it comes to attitudes on the personal benefits from mining the trend, that attitudes are more positive in the counties with coal mining, continues (Table 5.11.

Table 5.12 Attitude Questions over Human Concerns, Segregated by County

			Communities around mines are good places to live.	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
Human Concerns	**Communities around mines are good places to live.**			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	5.1%	7.1%	12.2%	75.5%
		Johnson		3.8%	12.5%	27.9%	55.8%
		Lincoln		21.0%	25.0%	39.0%	15.0%
	Mining is acceptable as long as it is carried out far from where people live.			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	27.4%	20.0%	21.1%	31.6%
		Johnson		21.2%	25.0%	28.8%	25.0%
		Lincoln		11.4%	25.7%	40.0%	22.9%

Again, a trend of more positive attitudes in counties with more coal mining can be seen in Table 5.12. This time towards statements about human concerns of mining.

Table 5.13 Attitude Questions over Economical Concerns, Segregated by County

Economical Concerns	Mining is important in many states in the United States.			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	0.0%	4.0%	10.0%	86.0%
		Johnson		.9%	2.8%	13.2%	83.0%
		Lincoln		0.0%	3.7%	22.2%	74.1%
	Mining is not important to the US economy.			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	85.9%	3.0%	4.0%	7.1%
		Johnson		87.9%	5.6%	1.9%	4.7%
		Lincoln		75.9%	12.0%	4.6%	7.4%
	Mining creates a lot of good jobs.			Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	County of Residence	Harlan	% within County of Residence	3.0%	2.0%	12.0%	83.0%
		Johnson		0.0%	.9%	7.5%	91.6%
		Lincoln		2.8%	0.0%	24.3%	72.9%

Once more, it can be seen that attitudes are more positive in counties that have coal mining than the county that does not (Table 5.13). The insights these tables provide are: 1) People around mines do not have negative attitudes towards mining, and 2) Areas not around mines should be targeted for educational efforts due to the fact that they have more negative attitudes towards mining.

The information provided in Tables 5.14 through 5.18 provides respondents' tested knowledge about the mining activities and effects and are segregated by county. Questions have been grouped into their corresponding areas of concern. In each case the correct answer has been highlighted. When reviewing the true/false responses keep in mind that there was a higher probability of selecting the correct answer given that there were only two choices when compared to the four choice questions.

Table 5.14 Knowledge Questions over Environmental Concerns, Segregated by County

Environmental Concerns	Reclamation is defined as:		The first step in mining where trees and topsoil are removed	Extracting minerals from the ground	Restoration of mined land to original contour, use,	Refining gold from ore.
	County of Residence	Harlan	9.1%	15.9%	73.9%	1.1%
		Johnson	4.0%	9.1%	82.8%	4.0%
		Lincoln	15.1%	15.1%	66.7%	3.2%
	What percentage of land has mining disturbed in America?		0%	0.5% -Half of 1 percent	5%	50%
	County of Residence	Harlan	6.2%	24.7%	51.5%	17.5%
		Johnson	1.0%	33.0%	59.0%	7.0%
		Lincoln	.9%	21.7%	62.3%	15.1%
	Mining companies take environmental impact into account when planning a mine.		True	False		
	County of Residence	Harlan	85.0%	15.0%		
		Johnson	88.7%	11.3%		
		Lincoln	78.3%	21.7%		
	After mining is done the land is restored.		True	False		
	County of Residence	Harlan	80.6%	19.4%		
		Johnson	88.6%	11.4%		
		Lincoln	69.8%	30.2%		

It can be seen in Table 5.14 that correct response percentages for questions about environmental aspects of mining were higher in the two coal producing counties than in the non-coal producing county.

Table 5.15 Knowledge Questions over Business Practices, Segregated by County

Business Practices		How much does the average miner earn each year?		$25,000	$40,000	$65,000	$100,000
			Harlan	3.1%	24.5%	61.2%	11.2%
		County of Residence	Johnson	2.0%	35.4%	58.6%	4.0%
			Lincoln	20.2%	51.0%	25.0%	3.8%
		Of these four professions which do you think is the most dangerous?		Agricultural Industry	Forestry Industry	Retail Industry	Mining Industry
			Harlan	10.8%	21.5%	7.5%	60.2%
		County of Residence	Johnson	13.1%	24.2%	7.1%	55.6%
			Lincoln	21.9%	13.3%	1.0%	63.8%
		How many more years can mining continue in the United States?		5 Years	10 Years	50 Years	100 Years
			Harlan	2.1%	10.4%	33.3%	54.2%
		County of Residence	Johnson	5.9%	6.9%	33.3%	53.9%
			Lincoln	6.8%	20.4%	28.2%	44.7%
		Canaries are still used to test the air in mines.		True	False		
			Harlan	20.6%	79.4%		
		County of Residence	Johnson	23.5%	76.5%		
			Lincoln	35.6%	64.4%		

It can be seen in Table 5.15 that correct response percentages for questions covering business practices of mining companies were higher in the two coal producing counties than in the non-coal producing county.

Table 5.16 Knowledge Questions over Economical Concerns, Segregated by County

	How many states have mines?		10	20	30	50
Economical Concerns	County of Residence	Harlan	25.8%	37.1%	26.8%	10.3%
		Johnson	25.7%	39.6%	31.7%	3.0%
		Lincoln	23.1%	33.7%	36.5%	6.7%
	What percentage of the US Gross Domestic Product is mining responsible for?		1%	4%	10%	25%
	County of Residence	Harlan	2.1%	18.1%	36.2%	43.6%
		Johnson	2.0%	21.2%	38.4%	38.4%
		Lincoln	4.9%	24.5%	34.3%	36.3%
	How many miners are in the US?		25,000	100,000	500,000	5 Million
	County of Residence	Harlan	9.7%	34.4%	40.9%	15.1%
		Johnson	12.4%	41.2%	39.2%	7.2%
		Lincoln	22.8%	45.5%	30.7%	1.0%

It can be seen in Table 5.16 that correct response percentages for questions over economic considerations of mining were higher in the two coal producing counties than in the non-coal producing county with the exception of the second economic question where the opposite is true. Respondents tended to overestimate the contribution of mining toward the US Gross Domestic Product.

Table 5.17 Knowledge Questions over Personal Benefit, Segregated by County

	How many pounds of mined material does the average American use every year?		400 lbs	4000 lbs	40,000 lbs	400,000 lbs
Personal Benefit	County of Residence	Harlan	17.6%	27.1%	28.2%	27.1%
		Johnson	19.8%	36.3%	30.8%	13.2%
		Lincoln	23.9%	32.6%	29.3%	14.1%
	What is the number one source of electricity in the US?		Coal	Hydroelectricity	Nuclear	Wind farms
	County of Residence	Harlan	90.8%	6.1%	2.0%	1.0%
		Johnson	92.5%	3.7%	3.7%	0.0%
		Lincoln	70.8%	23.6%	5.7%	0.0%
	You use the products of mining on a day to day basis.		True	False		
	County of Residence	Harlan	92.1%	7.9%		
		Johnson	95.3%	4.7%		
		Lincoln	84.9%	15.1%		

It can be seen in Table 5.17 that correct response percentages for questions over the personal benefit of mining were higher in the two coal producing counties than in the non-coal producing county. The exception to this was the first personal benefit question where the response percentages were relatively the same in all three counties.

Table 5.18 Knowledge Question about a Human Concern, Segregated by County

Human Concerns	Mining companies have complete control where mines can be.		True	False
	County of Residence	Harlan	26.5%	73.5%
		Johnson	9.3%	90.7%
		Lincoln	11.1%	88.9%

The targeting suggested by the attitude statement tables is supported by the knowledge questions. Educational efforts should be targeted at the county without coal production due to the lower correct response percentages for the various knowledge questions.

To proceed with any sort of communication or educational outreach without a survey like this would require making many conjectures about the audience. These assumptions could have unintended effects. The assumption is often made by those involved in the mining industry that they know what the public should know about mining and if the public only knew these facts then the opinions would shift in the industry's favor. This is the assumption that has spawned many different messages that highlight the everyday use of minerals in common products. The results from the question "You use the products of mining on a day to day basis" suggest these messages have been received (Table 5.17). The point is there should be foundation to any messages sent and that foundation should be, in part, determined by identifying negative attitudes or knowledge gaps.

Many such observations, which can guide an educational effort, can be made from the information provided (Tables 5.9 and 5.18). For example consider a message about reclamation. It was observed that in Harlan and Johnson counties 85% and 83% of the surveyed populations strongly agree with the statement that the mining process includes cleaning up after mining is done (Table 5.9). It could be argued that this is a substantial majority of the population, especially when you include those who somewhat agree with

the statement. In these cases continued messages about the reclamation process might not yield an improved attitude. On the other hand, the results for the attitude statement "Mining does not affect that much land." The attitudes are more divided here (Table 5.9). While "that much" is a subjective statement, it can be paired with the knowledge question, "What percentage of land has been disturbed by mining in the America?". The majority of those surveyed were wrong by an order of magnitude (Table 5.14). The difference between 5% (incorrect) of land disturbed and 0.5% (correct) could very well be the difference between much and not that much land. Messages could be designed from this observation that inform the actual amount of land affected by mining with the intention of increasing positive attitudes on this one facet of the mining process. This one example highlights the usefulness of this collected data. There are clearly numerous applications with the data collected regarding specific attitudes and knowledge of mining which can benefit individuals creating educational outreach efforts.

5.4 Self-Report of Knowledge and Relationship between Knowledge and Attitudes

One purpose of this dissertation is to address two questions. First, when you ask a person their level of knowledge about mining is their answer trustworthy? That is, is there a relationship between an individual's self report of knowledge about mining and an individual's tested level of knowledge about mining? Second, is there a relationship between a person's tested knowledge of mining and their attitudes towards mining?

Much of the educational material produced on behalf of the mining industry is based on the assumption that fact-based messages will bring about support for mining activities. The work presented in this section provides evidence that supports this assumption.

5.4.1 Attitude and Knowledge Data Processing

As was previously mentioned, positive and negative statements were read to the respondents to measure their attitude towards specific aspects of mining. When respondents gave the Likert answers of Strongly Disagree, Somewhat Disagree, Somewhat Agree, and Strongly Agree to each attitude statement, each was coded as a 1, 2, 3 or, 4 respectively. These values were summed across the questions being analyzed to produce an attitude sum. Since a total attitude score towards mining was of interest, the

coded values on the negative mining statements were reverse-coded for the analysis. An attitude ratio was then calculated by taking the attitude sum for the questions being examined and dividing it by the number of questions multiplied by the maximum Likert value possible for the individual questions (Equation 5.1). This maximum value was always four in this survey. This calculation original to this study requires that all Likert questions share the same response scale.

$$Attitude\ Ratio = \frac{\sum L}{n \times l_m}$$

[5.1]

$$where: L = Respondent\ Likert\ Value\ for\ each\ question$$
$$n = Number\ of\ Likert\ Statements$$
$$l_m = Maximum\ Likert\ value\ possible$$

Since there were 17 attitude questions, the lowest attitude sum an individual could have was 17 and the highest was 68. These sums were then divided by the maximum product of 68 to produce an attitude ratio. The range of total attitude ratios range from 0.25 to 1. With 0.25 being a very negative overall attitude towards mining and 1 being a very positive overall attitude towards mining. This same computation was conducted for each of the five areas of concern. If a respondent refused to answer or gave the answer of don't know to any of the attitude statements then a total attitude ratio could not be generated.

The knowledge questions were processed in a dichotomous manner. Respondents either got the question correct or incorrect. Those who answered "Don't Know" were scored as getting the question incorrect. If they refused to answer a total knowledge score could not be calculated; however, a knowledge sub-score could still be possible if they answered all the questions in an area. Knowledge scores were then calculated by summing up the number of correctly answered questions a respondent provided and dividing that value by the total number of questions. Any given respondent's knowledge score could range from 0 to 1, zero meaning an individual answered none of the questions correctly and a 1 means they answered all of the questions correctly.

5.4.2 Self-Report of Knowledge and Attitude vs. Tested Knowledge Results

An individual's self-report of knowledge was measured using the question: "How much would you say you know about mining in the United States, overall?" Responses were: No Knowledge, Very Little Knowledge, Some Knowledge, or A Good Deal of Knowledge. These were coded as 1, 2, 3, or 4 respectively. An analysis was conducted to answer the research question about a person's ability to accurately report their own level of knowledge about mining. Is there a relationship between an individual's self-report of knowledge about mining and an individual's tested level of knowledge about mining? A Spearman's correlation coefficient was used to determine if a relationship was present. Data were analyzed using IBM's Statistical Package for Social Sciences Version 21 (SPSS 21).

The Spearman correlation coefficient addressed the relationship between the rank scores for an individual's self-report on knowledge about mining and the tested knowledge of 317 individuals living in Kentucky. The observed correlation was found to be statically significant, $r_s = 0.319$, $p < 0.000$, suggesting that the more a person believes they know about mining, the actual tested knowledge about mining also increases.
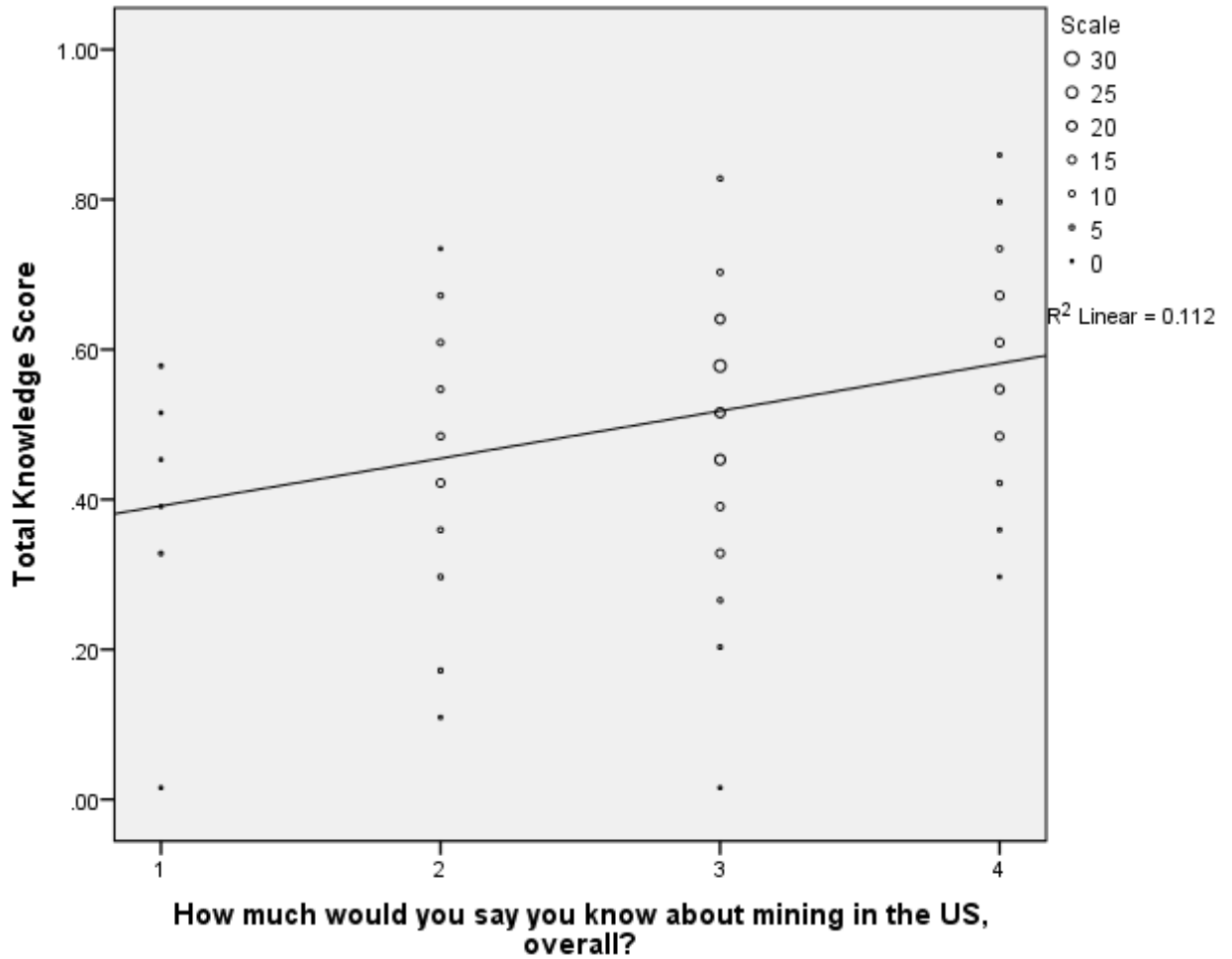
Figure 5.3 Self-Report of Knowledge vs. Total Knowledge Score

This data is graphically represented in a scatter plot seen in Figure 5.3, and a linear trend line was added. Since there were overlapping data points the binning function in SPSS 21 was used to graphically represent the relationship between an individual's self-report of knowledge and their total knowledge score (Figure 5.3). Each point on the graph represents several individuals that had the same self-report value and total knowledge score. The size of the "bin" (diameter of the circle) is related to the number of individuals represented by that point, and this relationship is provided in the graph's Scale legend.

The research question, "Is there a relationship between a person's tested knowledge and their attitudes towards mining?" was answered using the results from the survey. With the assumptions met, the Spearman correlation coefficient was determined

for addressing the relationship between the variables tested level of knowledge score and the overall attitudes ratio.

The Spearman correlation coefficient measured the relationship between the rank scores of individuals' total attitude ratios and the tested knowledge scores of 226 individuals living in Kentucky. The correlation was found to be statistically significant, $r_s = 0.419$, $p < 0.000$, suggesting that the more a person knows about mining, the more positive their attitudes are towards mining.
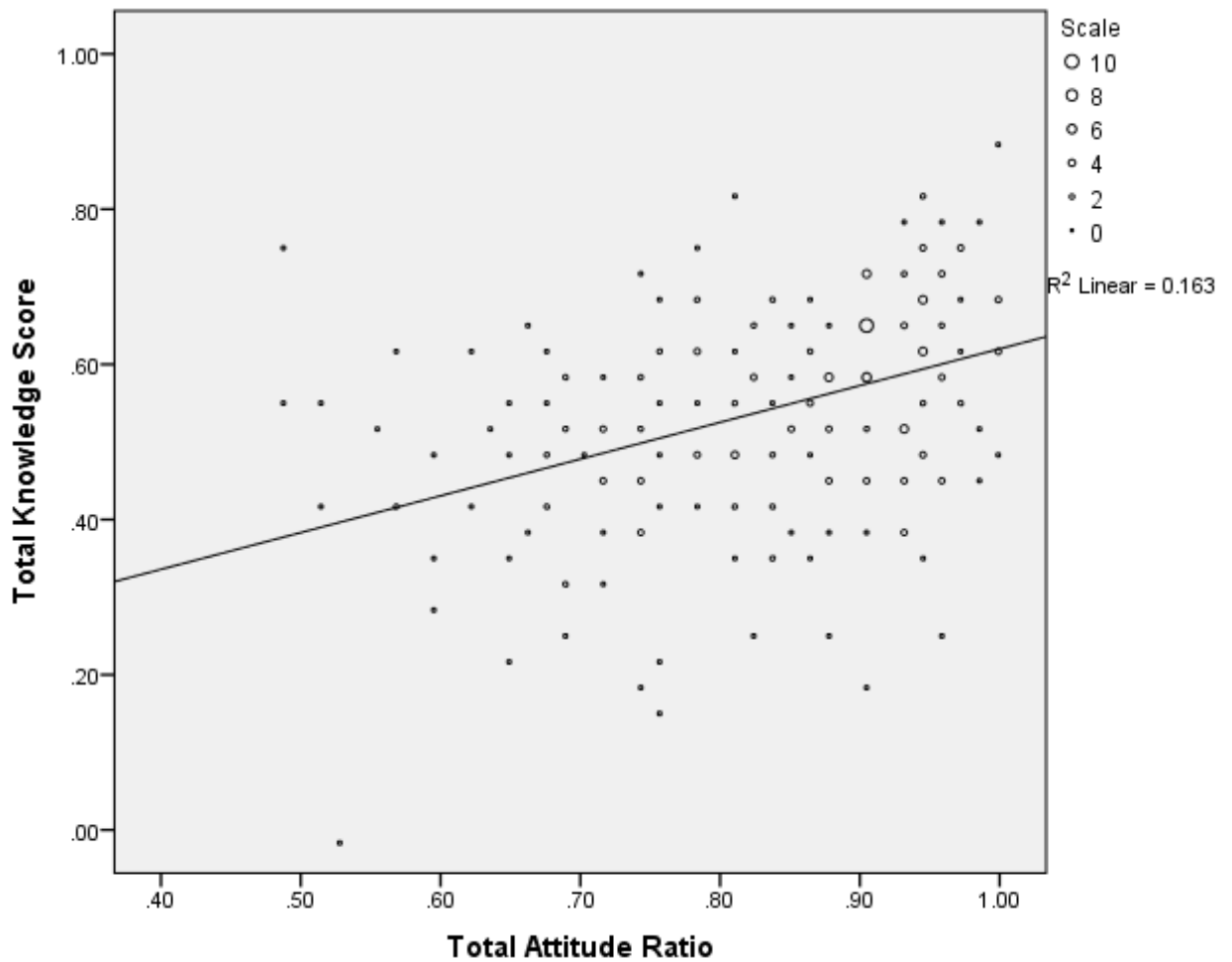
Figure 5.4 Total Attitude Ratio vs. Total Knowledge Score

An upward trend is visible when this data is graphed in a scatter plot. This relationship between knowledge and attitudes was graphed using the same approach that was used in Figure 5.3 (Figure 5.4).

Given that the Spearman's correlation coefficient suggests that attitudes towards mining become more positive as knowledge about mining increases, the assumption that fact-based messages about mining are useful for improving mining's image is supported. Identifying specific areas where there is a knowledge gap can be deemed useful for message selection. The knowledge questions were ranked based on the frequency responses from the sample surveyed. There was a range from 314 to 317 respondents, since the option to refuse to answer was allowed. The questions are ranked from low to high by percentage of correct responses to the questions, and correct responses are highlighted (Table 5.19).

Table 5.19 Knowledge Questions Ranked by Correct Responses

How many states have mines?	10	20	30	50	Don't Know
	23.7%	35.0%	30.3%	6.3%	4.7%
Of these four professions which do you think is the most dangerous?	Agricultural Industry	Forestry Industry	Retail Industry	Mining Industry	Don't Know
	14.6%	18.4%	4.8%	56.5%	5.7%
What percentage of the US Gross Domestic Product is mining responsible for?	1%	4%	10%	25%	Don't Know
	2.8%	19.9%	33.8%	36.6%	6.9%
How many pounds of mined material does the average American use every year?	400 lbs	4000 lbs	40,000 lbs	400,000 lbs	Don't Know
	17.5%	27.3%	25.1%	15.2%	14.9%
What percentage of land has mining disturbed in America?	0%	0.5% -Half of 1 percent	5%	50%	Don't Know
	2.5%	25.2%	55.2%	12.6%	4.4%
How many miners are in the US?	25,000	100,000	500,000	5 Million	Don't Know
	13.9%	37.3%	33.9%	7.0%	7.9%
How much does the average miner earn each year?	$25,000	$40,000	$65,000	$100,000	Don't Know
	8.3%	35.7%	45.9%	6.1%	4.1%
How many more years can mining continue in the United States?	5 Years	10 Years	50 Years	100 Years	Don't Know
	4.8%	12.1%	30.2%	48.6%	4.4%
Reclamation is defined as:	The first step in mining where trees and topsoil are removed	Extracting minerals from the ground	Restoration of mined land to original contour, use,	Refining gold from ore.	Don't Know
	8.2%	11.7%	66.1%	2.5%	11.4%
Canaries are still used to test the air in mines.	True	False	Don't Know		
	24.9%	68.5%	6.6%		
After mining is done the land is restored.	True	False	Don't Know		
	77.8%	19.9%	2.2%		
Mining companies take environmental impact into account when planning a mine.	True	False	Don't Know		
	82.6%	15.8%	1.6%		
What is the number one source of electricity in the US?	Coal	Hydroelectricity	Nuclear	Wind farms	Don't Know
	83.0%	11.0%	3.8%	0.3%	1.9%
Mining companies have complete control where mines can be.	True	False	Don't Know		
	15.1%	83.6%	1.3%		
You use the products of mining on a day to day basis.	True	False	Don't Know		
	89.9%	9.1%	0.9%		

This information can be used to guide educational efforts to directly address areas of low knowledge about specific aspects of the mining process. Likewise, the

information in Table 5.19 can also advise as to certain messages that could be considered a lower priority due to the fact that a higher percentage of the surveyed sample responded with a correct answer.

5.5 Attitudes vs. Demographics

The research question, "What relationships exist between a population's demographics, attitudes about mining, and knowledge of mining?" will be discussed in this section.

Initially, ordinal logistic regression was planned to be used to produce a model based on specific demographic variables to predict attitudes; however, one of the major assumptions of ordinal logistic regression was not met. Ordinal logistic regression can be used to predict specific outcome scores that are ordinal in nature. In this case, a model could be used to predict specific attitudes; however, if during data collection there are not enough participants who responded in all the possible response options, then an accurate model cannot be formed. For example, if no republicans report low attitude scores, then the statistic has no data to build a model off of in order to predict such occurrences. In short, all possible response options from participants must occur to some degree in order for ordinal logistic regression to produce a meaningful model. If this assumption is ignored an inaccurate and un-meaningful model would be produced.

Therefore, Kruskal-Wallis tests and *post hoc* Mann-Whitney tests were performed between the samples defined by the various demographics to determine if any differences in attitudes existed amongst them. Samples were defined by the seven variables: county of residence, age, gender, political party affiliation, education level, household income before taxes, and relationship to somebody involved with mining. Although ethnicity was asked in the survey, only 11 of the 317 individuals responded with an answer other than white. As a result, sample sizes in the other categories were not high enough to conduct any statistical analysis that would yield meaningful conclusions.

County of Residence vs. Attitudes

The survey collected information on the respondent's county of residence via the telephone number that the respondent was reached at. Again, the three counties were Harlan, Johnson, and Lincoln. The results from the Kruskal-Wallis test showed that there

were significant differences in attitudes amongst the three counties. $H(2) = 24.919$, $p < 0.05$. Post hoc Mann-Whitney tests were used to determine where the differences occurred. A Bonferroni correction was applied to reduce Type 1 error. Since three Mann-Whitney tests were run, a 0.0167 significance level was used. These tests showed that there was no difference in total attitude ratios between Harlan and Johnson Counties ($U = 2943$, $r = -0.889$, $p > 0.0167$). Differences were however shown in attitudes between Harlan and Lincoln ($U = 1515.5$, $r = -0.366$, $p < 0.0167$) as well as Johnson and Lincoln ($U = 1613.5$, $r = -0.347$, $p < 0.0167$). Attitudes about mining were significantly higher in Harlan than Lincoln, and significantly higher in Johnson than Lincoln. Recall that Harlan was the high coal producing county, Johnson was the medium coal producing county, and Lincoln had no coal production. From this test it can be concluded that counties with higher mining activities have residents with significantly more positive attitudes towards mining than the county without mining. This would also be a reason to target areas with little or no mining for educational efforts as their attitudes are lowest there.

Age vs. Attitudes

The survey collected information on age in the form of year the respondent was born. This was done for two reasons. First, asking the year of birth is less threatening than asking age (Bradburn, Wansink, and Sudman, 2004). Second, the data could easily be collapsed into ranges of age. Populations were defined on the age dimension by ten year increments ranging from 18 to 87. This resulted in having seven age brackets. A Kruskal-Wallis tests was performed on these age groups to determine if any differences were present in the attitudes of these age groups. The results suggest that no significant differences in total attitude ratios were present between the age groups, $H(6) = 8.66$, $p > 0.05$.

Gender vs. Attitudes

A Kruskal-Wallis tests was performed on the gender populations to determine if any differences were present in the attitudes of these groups. The results suggest that no significant differences in total attitude ratios were present between males and females, $H(1) = 0.14$, $p > 0.05$.

Political Party vs. Attitudes

The question about political affiliation was open-ended and were recorded as Democrat, Independent, Republican, Other, Don't Know, or Refused to Answer. If the respondent answered with Independent, a follow-up question was asked if they leaned towards the democrats, republicans or neither, and this too was recorded. These responses were later collapsed to the categories of Republican, Independent, and Democrat while Other, Don't Know, and Refusals were removed for this analysis. The categories were collapsed because there were few numbers of respondents who identified as Independents leaning republican, democrat, or neither.

The Kruskal-Wallis test showed that significant differences in total attitude scores existed between political party affiliation, $H(2) = 21.968$, $p < 0.05$. Post hoc Mann-Whitney tests were used to determine where the differences occurred. With the two planned post hoc Mann-Whitney tests, a Bonferroni correction was applied so that a 0.025 level of significance was used to reduce Type 1 error. These tests showed that there were differences in total attitude ratios between Democrats and Republicans ($U = 3093$, $r = -0.324$, $p < 0.025$) as well as Independents and Republicans ($U = 644.5$, $r = -0.207$, $p < 0.025$). Attitudes about mining were significantly higher among Republicans compared to Democrats, and significantly higher among Republican compared to Independents.

Education Level vs. Attitudes

The question to obtain information about a person's educational attainment was worded, "What is the last grade you competed in school?" Responses were: Grade School Only, Some High School, High School or GED, Associates Degree, Bachelors of Arts, Bachelors of Science, Masters, Doctorate of Philosophy, Medical Degree, Don't Know, and Refused to Answer. Due to low response rates in some categories these results were collapsed to: Grade School Only, Some High School, High School or GED, Associates Degree, Bachelors Degree, and Masters, while Doctorate of Philosophy, Medical Degree, Don't Know, and Refusals were removed for this analysis. There were no participants in the data set with a medical degree and only one with a PhD.

The Kruskal-Wallis test showed that significant differences in total attitude scores existed between the different levels of education, $H(5) = 18.377$, $p < 0.05$. Post hoc Mann-Whitney tests were used to determine where the differences occurred. With three planned post hoc Mann-Whitney tests, a Bonferroni correction was applied at a 0.0167 level of significance. These tests showed that there were differences in total attitude ratios between Associates and Masters ($U = 226.5$, $r = -0.379$, $p < 0.0167$). However no differences were shown in total attitude ratios between High School/GED and Associates ($U = 1781.5$, $r = -0.192$, $p > 0.0167$) nor between Associates and Bachelors ($U = 446.5$, $r = -0.240$, $p > 0.0167$). Attitudes about mining were significantly higher among those with an Associate degree than those with a Masters degree.

Household Income vs. Attitudes

To obtain information about total household income, the following question was asked, "Last year, what was your total household income from all sources before taxes?" Responses were: Under $5,000, $5-$7,500, $7,500-$10,000, $10-$12,500, $12,500-$15,000, $15,000-$20,000, $20-$25,000, $25-$30,000, $30-$40,000, $40-$50,000, $50-$70,000, $70-$90,000, $90-$120,000, Over $120,000, Don't Know, and Refused to Answer. These results were collapsed to Under $30,000, $30-$50,000, $50,000-$70,000, $70-$90,000, $90-$120,000, and above $120,000. The responses of Don't Know and Refusals were not used in this analysis.

The Kruskal-Wallis test showed that significant differences in total attitude scores existed between levels of income, $H(5) = 18.942$, $p < 0.05$. Post hoc Mann-Whitney tests were used to determine where the differences occurred. Two post hoc Mann-Whitney tests were planned, so a Bonferroni correction of a 0.025 level of significance was applied. These tests showed that there were significant differences in total attitude ratios between the income levels of $50-$70,000 and $70-$90,000 ($U = 139.5$, $r = -0.343$, $p < 0.025$) but not differences between the income levels of $70-$90,000 and $90-$120,000 ($U = 135$, $r = -0.167$, $p > 0.025$). Attitudes about mining were significantly higher among the income range of $70-$90,000 compared to $50-$70,000.

Relationship to Miner vs. Attitudes

To obtain information about the closest relationship of a miner to the respondent, the following question was posed: "Can you think of a person or persons who work in the mining industry?" If the responded answered Yes then they were asked, "Who is the person closest to you that works in the mining industry?" Responses were Myself, Immediate Family (e.g. Brother, Sister, Mother, Father, Son, or Daughter), Relative, Friend, Neighbor, Acquaintance, Other, Don't Know, and Refused to Answer. Don't Knows were entered as Knows Nobody in the mining industry. Refusals were not used in this analysis.

The Kruskal-Wallis test showed that significant differences in total attitude scores existed between the different relationships to an employee in the mining industry, $H(7) = 38.723$, $p < 0.05$. Post hoc Mann-Whitney tests were used to determine where the differences occurred. Three post hoc Mann-Whitney tests were planned, so Bonferroni correction at a 0.0167 level of significance was used. These tests showed that there was differences in total attitude ratios between Myself and Friend ($U = 240.5$, $r = -0.351$, $p < 0.0167$), Myself and Knows Nobody ($U = 266$, $r = -0.522$, $p < 0.0167$), and Friend and Knows Nobody ($U = 433$, $r = -0.352$, $p < 0.0167$). Attitudes about mining were significantly higher between the subpopulation who were involved with mining and the subpopulation that knew a friend involved with mining. Attitudes were also significantly higher between the subpopulation who were involved with mining and the subpopulation that knew nobody involved with mining. The subpopulation that knew a friend involved with mining had significantly higher attitudes than the subpopulation that knew nobody involved with mining.

Within the spectrum of relationship choices, three levels are evident. Those who answered myself, immediate family, and relative share statistically similar attitudes and are significantly higher than those that answered friend, neighbor, acquaintance, or other. In turn those who answered friend, neighbor, acquaintance, or other share statistically similar attitudes and are significantly higher than those that answered knows nobody. From these tests it can be concluded that the closer an individual is to somebody involved with mining the higher their attitudes will be.

5.6 Multiple Regression Model for Predicting Knowledge

A multiple regression model was used to identify a model of specific demographic variables that would best predict a person's total tested knowledge score. All assumptions of multiple regression were met, indicating it was an appropriate test to use for the following research question: Can knowledge of mining be predicted from demographic information?

First, all predictor variables (demographic variables) were included in the model to see if it produced a significant model. While it did indeed produce a significant model to predict total knowledge, it was not the most efficient model possible. Therefore, forward entry was used in the multiple regression model to determine the best predictors for total knowledge. Forward entry means that predictor variables are entered into the model one at a time. A model statistic is determined with each new variable addition. If there continues to be significant changes in the model statistic, then those variables explain a statistically significant amount of the variance in the model. If a variable is added to the model and there is no significant change in the model statistic then that variable does not significantly contribute to the model and its inclusion in the model is deemed inefficient and unnecessary. When forward entry was used on this data set, the final model included four variables that best predicted total knowledge. The final model explained 31.7% of the variance in total knowledge score with the following variables: total household income, political party affiliation, relation to a miner, and age, $F(21, 200)$ = 4.412, $p < 0.000$. Income was also the single greatest predictor, explaining 15.6% of the variance in total knowledge score. The final model yielded Equation 5.2. This equation is used to predict K; which is the total number of knowledge questions that would be answered correctly by an individual out of a maximum of 15 possible points. Table 5.20 outlines the decision logic for inputting values for the demographic variables.

$$K = 9.416 + (0.987\, I_1 + 0.665\, I_2 + 0.1.22\, I_3 + 1.018\, I_4 + 1.897\, I_5) +$$
$$(-0.832\, P_1 - 0.977\, P_2) + (-0.945\, R_1 - 0.999\, R_2 - 0.858\, R_3 - 2.712\, R_4 -$$
$$1.423\, R_5 - 1.954\, R_6 - 1.846\, R_7) + (-0.491\, A_1 - 1.225\, A_2 + 0.1.78\, A_3 -$$
$$0.776\, A_4 - 0.656\, A_5 - 1.44\, A_6 - 3.57\, A_7) + \varepsilon_i$$

[5.2]

Table 5.20 Model Variable Logic

Demographic Category	Income Variables				
	I₁	I₂	I₃	I₄	I₅
Income is under $30,000	0	0	0	0	0
Income is between $30,000 to $50,000	1	0	0	0	0
Income is between $50,000 to $70,000	0	1	0	0	0
Income is between $70,000 to $90,000	0	0	1	0	0
Income is between $90,000 to $120,000	0	0	0	1	0
Income is over $120,000	0	0	0	0	1

	Political Variables						
	P₁		P₂				
Republican	0		0				
Democrat	1		0				
Independent	0		1				

	Relation to Miner Variables						
	R₁	R₂	R₃	R₄	R₅	R₆	R₇
Person they know in mining is their self	0	0	0	0	0	0	0
Person they know in mining is immediate family	1	0	0	0	0	0	0
Person they know in mining is relative	0	1	0	0	0	0	0
Person they know in mining is friend	0	0	1	0	0	0	0
Person they know in mining is neighbor	0	0	0	1	0	0	0
Person they know in mining is acquaintance	0	0	0	0	1	0	0
Person they know in mining is other	0	0	0	0	0	1	0
Knows nobody in mining	0	0	0	0	0	0	1

	Age Variables						
	A₁	A₂	A₃	A₄	A₅	A₆	A₇
Age is between 18 and 27	1	0	0	0	0	0	0
Age is between 28 and 37	0	1	0	0	0	0	0
Age is between 38 and 47	0	0	1	0	0	0	0
Age is between 48 and 57	0	0	0	0	0	0	0
Age is between 58 and 67	0	0	0	1	0	0	0
Age is between 68 and 77	0	0	0	0	1	0	0
Age is between 78 and 87	0	0	0	0	0	1	0
Age is between 88 and 97	0	0	0	0	0	0	1

An example of how Equation 5.2 is put into practice will be demonstrated. Consider an individual who indicated they earned between $50,000 and $70,000, was a democrat, knew nobody in mining, and was between 58 to 67 years old. Using the logic below Equation 5.2 the equation would result in the following:

$$K = 9.416 + (0.987 * 0 + 0.665 * 1 + 0.1.22 * 0 + 1.018 * 0 + 1.897 * 0) +$$

$$(-0.832 * 1 - 0.977 * 0) + (-0.945 * 0 - 0.999 * 0 - 0.858 * 0 - 2.712 * 0 -$$

$$1.423 * 0 - 1.954 * 0 - 1.846 * 1) + (-0.491 * 0 - 1.225 * 0 + 0.1.78 * 0 -$$

$$0.776 * 1 - 0.656 * 0 - 1.44 * 0 - 3.57 * 0) + \varepsilon_i$$

This then reduced to:

$$K = 9.416 + (0.665 * 1) + (-0.832 * 1) + (-1.846 * 1) + (-0.776 * 1) + \varepsilon_i$$

Which equals:

$$K = 6.627 + \varepsilon_i$$

Three individuals out of the 317 who were surveyed matched this definition. Their number of knowledge questions they answered correctly were 7, 9, and 2.

Caution should be made in regard to generalization to the population at large since this model used data from three counties in Kentucky. It is also important to note that no participants made a perfect score on the knowledge questions, therefore the data were slightly constrained within the model.

5.6 Barriers to Actions Regarding Mining

It has been shown that there are correlations between individuals' level of knowledge and their attitude towards mining. This upward trend between knowledge and attitudes supports the rationale behind much of the educational efforts on behalf of the mining industry. Increased positive attitudes towards the mining industry alone falls short of any real positive effects without bringing about positive behaviors or actions. What is the point of educating somebody if it does not affect their behaviors or actions?

The purpose of this chapter is to describe samples that have or have not performed actions that could potentially have an impact on the mining industry. Groups that have performed certain actions were compared to those who did not perform those actions. Statistical analysis were performed to determine if there were statistically significant differences in attitudes and knowledge between groups based on how they voted, if they made formal complaints against a mining company, or attended rallies.

The Total Attitude Ratios and Total Knowledge Scores of the populations defined by the respondent's answers to the action are presented in Tables 5.21 and 5.22. The

values in the table are statistical descriptors of the Total Knowledge Scores and the Total

Attitude Ratios for the groups that did or did not perform the actions.

Table 5.21 Knowledge Scores Among Action Populations

Knowledge Scores for Action Populations							
Have you ever made a formal complaint against a mining company?	Mean	N	Std. Deviation	Range	Median	Minimum	Maximum
No	.52	296	.15	.87	.53	0.00	.87
In the past 5 Years	.54	6	.09	.27	.53	.40	.67
More than 5 Years	.43	8	.13	.33	.47	.27	.60
Have you ever voted for a political candidate because of their pro-mining position?	Mean	N	Std. Deviation	Range	Median	Minimum	Maximum
No	.49	210	.15	.80	.47	0.00	.80
In the past 5 Years	.57	91	.14	.60	.60	.27	.87
More than 5 Years	.56	9	.15	.47	.60	.20	.67
Have you ever voted for a political candidate because of their anti-mining position?	Mean	N	Std. Deviation	Range	Median	Minimum	Maximum
No	.52	288	.15	.87	.53	0.00	.87
In the past 5 Years	.52	19	.19	.80	.53	0.00	.80
More than 5 Years	.36	3	.08	.13	.40	.27	.40
Have you ever attended a pro-mining rally?	Mean	N	Std. Deviation	Range	Median	Minimum	Maximum
No	.50	258	.15	.80	.53	0.00	.80
In the past 5 Years	.60	40	.14	.60	.60	.27	.87
More than 5 Years	.59	11	.09	.26	.60	.47	.73
Have you ever attended an anti-mining rally?	Mean	N	Std. Deviation	Range	Median	Minimum	Maximum
No	.52	304	.15	.87	.53	0.00	.87
In the past 5 Years	.62	3	.22	.40	.53	.47	.87
More than 5 Years	.49	3	.03	.06	.47	.47	.53

Table 5.22 Attitude Ratios Among Action Populations

Attitude Ratios for Action Populations							
Have you ever made a formal complaint against a mining company?	Mean	N	Std. Deviation	Range	Median	Minimum	Maximum
No	.84	215	.11	.51	.87	.49	1.00
In the past 5 Years	.78	6	.23	.49	.82	.51	1.00
More than 5 Years	.76	7	.14	.40	.72	.56	.96
Have you ever voted for a political candidate because of their pro-mining position?	Mean	N	Std. Deviation	Range	Median	Minimum	Maximum
No	.79	136	.12	.51	.81	.49	1.00
In the past 5 Years	.91	84	.07	.38	.93	.62	1.00
More than 5 Years	.84	8	.10	.29	.87	.65	.94
Have you ever voted for a political candidate because of their anti-mining position?	Mean	N	Std. Deviation	Range	Median	Minimum	Maximum
No	.84	209	.11	.51	.87	.49	1.00
In the past 5 Years	.81	18	.14	.48	.85	.51	.99
More than 5 Years	.51	1		0.00	.51	.51	.51
Have you ever attended a pro-mining rally?	Mean	N	Std. Deviation	Range	Median	Minimum	Maximum
No	.82	182	.12	.51	.85	.49	1.00
In the past 5 Years	.91	36	.10	.44	.95	.56	1.00
More than 5 Years	.89	10	.07	.22	.89	.78	1.00
Have you ever attended an anti-mining rally?	Mean	N	Std. Deviation	Range	Median	Minimum	Maximum
No	.84	223	.12	.51	.87	.49	1.00
In the past 5 Years	.76	2	.28	.40	.76	.56	.96
More than 5 Years	.79	3	.09	.17	.78	.71	.88

An analysis was conducted to determine if there were significant differences in attitudes and knowledge between groups based on how they voted, if they made formal complaints against a mining company, or attended rallies. With all three assumptions for the Kruskal-Wallis test satisfied this test was appropriate for testing the variables of total knowledge score, total attitude ratio, and the various actions. Recall the Kruskal-Wallis tests only identifies when samples are different from one another, but not where their differences occur. When differences were confirmed and more than two samples were present, *post hoc* Mann-Whitney tests were performed to determine where the differences occurred. The Mann-Whitney tests used the ranked knowledge scores and ranked attitude ratios between the groups to determine further differences in the actions of voting for a political candidate because of their pro-mining position, and attending a pro-mining rally. Bonferroni corrections were applied to the post hoc Mann-Whitney tests.

Complaint against a mining company vs. Knowledge

A Kruskal-Wallis test was performed on the formal complaint action groups to determine if any differences were present in knowledge scores. The results suggest that no significant differences in total knowledge scores were present between those who have made a formal complaint against a mining company in the past five years, more than five years and never, $H(2) = 2.92$, $p > 0.05$. It is important to note the small sample size of individuals that made of formal complaint ($N = 14$).

Voted for Pro-Mining Candidate vs. Knowledge

A Kruskal-Wallis test was performed on the pro-mining voting action groups to determine if any differences were present in knowledge scores. The results suggest that significant differences in total knowledge scores were present between those who have voted for a political candidate based on their pro-mining stance in the past five years, more than five years, and never, $H(2) = 15.86$, $p < 0.05$. *Post hoc* Mann-Whitney tests were used to determine where the differences occurred. Three *post hoc* Mann-Whitney tests were planned, so a Bonferroni correction of a 0.0167 level of significance was used. These tests showed that there were significant differences in total knowledge scores between the action group that had voted for a pro-mining candidate in the past five years and the group that had never voted for a pro-mining candidate ($U = 6927$, $r = -0.22$, $p < 0.0167$). Differences in knowledge were not evident between the groups that voted in the past five years and more than five years ($U = 400.5$, $r = -0.01$, $p > 0.0167$). Nor were they shown to exist between the groups that voted for a pro-mining candidate more than five years ago and never ($U = 662.5$, $r = -0.01$, $p > 0.0167$). In all, the group that voted for a pro-mining candidate in the past five years had significantly higher knowledge scores than the group that never voted for a pro-mining candidate. The knowledge scores averaged across these groups were 0.57 and 0.49, respectively.

Voted for Anti-Mining Candidate vs. Knowledge

A Kruskal-Wallis test was performed on the anti-mining voting action groups to determine if any differences were present in knowledge scores of these groups. The results suggest that no significant differences in total knowledge scores were present between those who voted for a political candidate based on their anti-mining stance in the

past five years, more than five years, and never, $H(2) = 4.35$, $p > 0.05$. It is important to note the small sample size of individuals that voted for an anti-mining candidate ($N = 22$).

Attended a Pro-Mining Rally vs. Knowledge

A Kruskal-Wallis test was performed on the pro-mining rally action groups to determine if any differences were present in the knowledge scores of these groups. The results suggest that significant differences in total knowledge scores were present between those who have attended an anti-mining rally in the past five years, more than five years, and never, $H(2) = 15.86$, $p < 0.05$. *Post hoc* Mann-Whitney tests were used to determine where the differences occurred. Two post hoc Mann-Whitney tests were planned, so a Bonferroni correction of a 0.025 level of significance was used. These tests showed that there were significant differences in total knowledge scores between the action group that attended for a pro-mining rally in the past five years and the group that never attended for a pro-mining rally ($U = 3282.5$, $r = -0.22$, $p < 0.025$). The group that attended a pro-mining rally in the past five years had significantly higher knowledge scores than the group that never attended a pro-mining rally. These knowledge scores averaged across these groups were 0.62 and 0.52, respectively.

Attended an Anti-Mining Rally vs. Knowledge

A Kruskal-Wallis test was performed on the anti-mining rally action groups to determine if any differences were present in the knowledge scores of these groups. The results suggest that no significant differences in total knowledge scores were present between those who attended an anti-mining rally in the past five years, more than five years, and never, $H(2) = 0.85$, $p > 0.05$. It is important to note the small sample size of individuals that attended an anti-mining rally ($N = 6$).

Complaint against a mining company vs. Attitudes

A Kruskal-Wallis test was performed on the formal complaint action groups to determine if any differences were present in the attitudes of these groups. The results suggest that no significant differences in total attitude ratios were present between those who have made a formal complaint against a mining company in the past five years, more

than five years and never, H(2) = 2.38, p > 0.05. It is important to note the small sample size of individuals that made of formal complaint (N = 13).

Voted for Pro-Mining Candidate vs. Attitudes

A Kruskal-Wallis test was performed on the pro-mining voting action groups to determine if any differences were present in the attitudes of these groups. The results suggest that significant differences in total attitude ratios were present between those who voted for a political candidate based on their pro-mining stance in the past five years, more than five years, and never, H(2) = 50.1, p < 0.05. *Post hoc* Mann-Whitney tests were used to determine where the differences occurred. Three *post hoc* Mann-Whitney tests were planned, so a Bonferroni correction of a 0.0167 level of significance was used. These tests showed that there were significant differences in total attitude ratios between the action group that voted for a pro-mining candidate in the past five years and the group that had never voted for a pro-mining candidate (U = 2493.5, r = -0.47, p < 0.0167). Differences in attitudes were not evident between the groups that voted in the past five years and more than five years (U = 178, r = -0.23, p > 0.0167). Nor were they shown to exist between the groups that voted for a pro-mining candidate more than five years ago and never (U = 436.5, r = -0.08, p > 0.0167). In summary, the group that voted for a pro-mining candidate had significantly higher attitude ratios than the group that never voted for a pro-mining candidate. These attitude ratios averaged across the groups were 0.91 and 0.79, respectively.

Voted for Anti-Mining Candidate vs. Attitudes

A Kruskal-Wallis test was performed on the anti-mining voting action groups to determine if any differences were present in the attitudes of these groups. The results suggest that no significant differences in total attitude ratios were present between those who voted for a political candidate based on their anti-mining stance in the past five years, more than five years and never, H(2) = 3.44, p > 0.05. It is important to note the small sample size of individuals that voted for an anti-mining candidate (N = 19).

Attended a Pro-Mining Rally vs. Attitudes

A Kruskal-Wallis test was performed on the pro-mining rally action groups to determine if any differences were present in the attitudes of these groups. The results suggest that significant differences in total attitude ratios were present between those who attended an anti-mining rally in the past five years, more than five years, and never, $H(2)$ = 28.82, $p < 0.05$. *Post hoc* Mann-Whitney tests were used to determine where the differences occurred. Three *post hoc* Mann-Whitney tests were planned, so a Bonferroni correction of a 0.0167 level of significance was used. These tests showed that there were significant differences in total attitude ratios between the action group that attended a pro-mining rally in the past five years and the group that never attended a pro-mining rally ($U = 1483.5$, $r = -0.35$, $p < 0.0167$). Differences in attitudes were not shown between the groups that attended a pro-mining rally in the past five years and more than five years ($U = 130$, $r = -0.20$, $p > 0.0167$). Nor were they shown between the groups that attended a pro-mining rally more than five years ago and never ($U = 604$, $r = -0.13$, $p > 0.0167$). In summary, the group that had attended a pro-mining rally in the past five years had significantly higher attitudes than the group that never attended a pro-mining rally. These attitude ratios averaged across the groups were 0.92 and 0.82, respectively.

Attended an Anti-Mining Rally vs. Attitudes

A Kruskal-Wallis test was performed on the anti-mining rally action groups to determine if any differences were present in their attitudes. The results suggest that no significant differences in total attitude ratios were present between those who attended an anti-mining rally in the past five years, more than five years and never, $H(2) = 1.05$, $p > 0.05$. It is important to note the small sample size of individuals that attended an anti-mining rally ($N = 5$).

Conclusions about Actions

It is evident from Table 5.21 that not only do individuals take a political candidate's stance toward mining into consideration, they vote for that person because of it. In fact, 100 or 32% of the 309 individuals did just that. By analyzing the attitude ratios and knowledge scores of these samples a measurable target can be set for educational efforts with the intention of increasing knowledge and attitudes with the

assumption that increasing knowledge and attitudes to the levels of the sample that voted for a pro-mining candidate would drive them to do the same. This is a very good reason why educational efforts can have a meaningful impact on the mining industry.

6.1 Applying a Social Judgment Theory Model

The purpose of this work was to use theoretical foundations to guide and explain the determination of attitudes and knowledge the public has about mining for the purpose of evaluating the effectiveness of educational messages about the mining industry. It has already been shown that positive attitudes about mining increase with increased knowledge about mining. Targets for attitude levels have also been suggested with the assumption that these higher attitude levels lead to actions which benefit the mining industry. Specific areas have also been highlighted where knowledge gaps exist and there is room for promulgating messages to address these gaps. Next, what messages successfully educate and therefore increase positive attitudes towards mining should be considered.

Currently, there are many grassroots programs that have the intention of educating people about the importance of mining. These programs are often implemented at a local level and rely upon volunteer support as they work with limited resources. From these programs there exist a plethora of educational materials and resources. However, many of these materials are beginning to become dated in appearance and mode of message delivery. In addition, the effectiveness of these materials is not known and little has been done to verify their usefulness at imparting a retained message to the intended audience. The following is a non-exhaustive list of entities that have produced educational materials:

- Kentucky Coal Association (KCA)
- Kentucky Coal Foundation
- Friends of Coal
- Colorado Mining Association (CMA)
- West Virginia Coal Association
- Minerals Education Coalition (MEC)
- Caterpillar Inc.
- SME Foundation
- Rocky Mountain Coal Mining Institute (RMCMI)

- SME Coal and Energy Division

With guidance from the survey results and a library of educational material to draw upon, outreach and educational efforts can be designed and tested for effectiveness.. The evaluation of the educational messages can be framed using Social Judgment Theory using the attitude questions and the Total Attitude Ratio provided by the survey developed through this work. An individual's total attitude ratio before the introduction of any educational materials would be their anchor on the judgment spectrum (Figure 6.1). The same attitude questions would be asked of that individual after the messages have been delivered. Ideally, these questions could also be asked for an additional follow-up at six months or a year to test for retention of messages. A shift in their anchor point on the spectrum in the intended direction would be indicative of successful messages rooted in knowledge that affected attitude. This would be quantified by calculating an individual's new attitude ratio. Potential backlash or boomerang effects from ineffective materials will also be brought to light should the anchor point be shifted in the unintended direction. If no change occurs it can be concluded that the message fell outside the individuals latitude of acceptance, was assimilated, or was contrasted. In any which case no persuasion was made through the message.
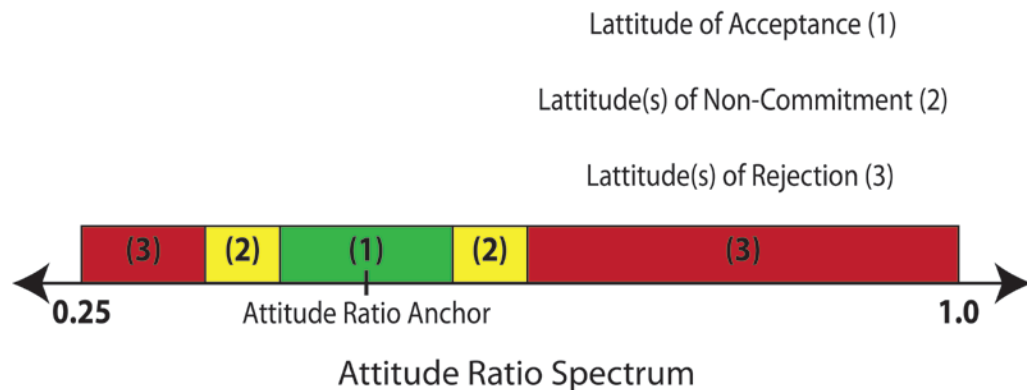
Figure 6.1 Applied SJT Model

To build a worthwhile model, an extensive latitude study would need to be conducted. However, over time, generalizations of specific populations could be made, latitudes for those populations could be mapped, and knowledge of which messages were successful on specific populations would be created. The result would be the ability to measure individuals' attitude and make predictions about which messages that would

76

most likely be received positively. Barriers to acceptance would be determined such as ego-involvement. It is known that ego involvement can be a huge barrier to any message's persuasive ability. This framework is therefore probably best for the general public who are not directly involved with or affected by the mining industry, whether it is for positive or negative reasons. The next section will introduce a theoretical framework for addressing these particular individuals.

6.2 Application of Maslow's Hierarchy of Human Needs

While SJT is a good theoretical approach to making attitudes more positive amongst populations not involved with or affected by mining, another is better suited for those who are directly affected by the mining industry. These populations are the ones near existing or future mine operations. Simple persuasive arguments or messages alone are not enough to sway these populations due to their vested interest. In this section, Maslow's classical theory of human motivation is framed to be a guidance method by which mine planners can logically create strategies toward gaining community support for new mine developments or expansions. Basic examples where Maslow's theory can explain community incentivization through actions of existing mines in different regions will be reviewed, as well as the proposition of fundamental guidance for applying this theory to new developments.

The purpose of this section is not to propose any revolutionary actions that a mining company can undertake to engage the stakeholders of a mine, but to propose a process to logically guide the selection community engagement activities. The debate of whether or not it is the mining industry's responsibility to participate in or create these activities is not considered in this section. The axiom presented in this section is that the methods of using Maslow's hierarchy is one means of identifying and brokering a solution to gain community and stakeholder support for a mine.

The level of need or the location on the hierarchy most appropriate for appeal will be referred to as the "community's targeted areas of benefit." These hypothetical imperatives are the items lacking by an individual or community where there is a perceived need. When it is proposed that improvement or provision be made by a mining company to the affected community, there is incentive to support mining activities. To

the criticism of this is a systematic means at determining how to buy a community. Do not confuse this with a bribe or some sort of compensation for a loss.   A bribe would assume the accounting that a deficit or loss incurred by a community is offset by some sort of return by the company. This instead is a way of explaining how a symbiotic relationship can be forged. This model assumes no negatives in the transaction. A gain-gain, if you will. Depletion of raw resources is neglected on the grounds that in-situ they are of no benefit or value to the community.

The formative research required to determine a community's targeted area of benefit could require a substantial amount of time. However, as the permitting process in itself is a time-intensive process, it is probably best to have these two tasks take place concurrently.   In addition, with the increased concern for environmental justice and community engagement, the process of defining ways the community could be benefited would do well to show due diligence in these areas. For the sake of brevity, a general outline and some key considerations for conducting this assessment will be discussed. Many of these steps are taken in normal feasibility studies but framing the gained knowledge in accepted theory allows for a more logical decision-making process.

Initial scope for the assessment process should be conducted at the country and regional level. Assessing a country's current level of development will provide insight into the types of basic infrastructure in place. This will be indicative of the types of needs that are currently fulfilled and the types of needs that are potential areas for improvement.   Regional evaluations may prove insightful in situations where two neighboring countries are in differential states of development.   The less-developed country may look to its neighbor with expectations for its next step. These neighboring countries will shape expectations of what is next on their development path. Institutions such as the World Bank Group have vested interest in keeping current data of the developmental progress of every country. These are good starting places for gauging the condition of a region or country.

A breakdown by country may not be enough resolution, especially when a country is geographically vast.   State or Provence level evaluation may be more appropriate. Eventually, assessments need to be made at the county or parish level. This is where the immediate stakeholders are identified. Although a general level of targeted

areas of benefit can be assessed through research, specific needs that are perceived to be important by the community should be understood. This can be accomplished through surveys and meetings with the community and immediate stakeholders.

Conversations with communities will not always be about benefits added but also the perceived risk of needs lost. When communities have what they need the perception of losing a basic need like water can explain why some communities react so vehemently to that perceived threat to their ground water supply. These concerns need to be addressed and actions to prevent the loss of these needs should be communicated. This process takes time and concerted effort. If done correctly, the local community may be a stronger proponent of a mine and can be a strong ally against criticism from entities outside of the local community.

Maslow's Hierarchy and Communities near Mining

To better understand how Maslow's Hierarchy of Human needs can be applied to mining, and moreover how mining companies can gain the acceptance of stakeholders around mining activities, actions of larger companies can be evaluated. The following are four examples of mining companies that have done this. Two examples are from developing or third-world countries (i.e. Ghana, Indonesia). The other two examples are from operations within the United States of America, a developed country. This division is important in relation to Maslow's classical Hierarchy of Human Needs as each set of stakeholders in these different regions will have different needs as well as existing fulfilled needs. This will be discussed in relation to how companies must appeal to a different set of human needs in Maslow's Hierarchy. The scope of this chapter will be limited to the fulfillment of the social needs of a community rather than needs of individuals in the community. The actions of companies from these examples and how they help in motivating stakeholders to approve of the presence of mining operations will be explained in terms of a classical theory of human motivation.

Developing and Underdeveloped Regions

The identification of targeted areas of benefit in places that have very little development is an easy task. Ensuring the ability to sustain basic life is a capital imperative, and situations where these types of infrastructures can be created makes

identification a fairly easy task. Appeals to the more basic of human needs are often the first to be made in developing regions.

Grasberg Mining Complex, Indonesia Freeport-McMoRan

The Grasberg Mining Complex in Papua, Indonesia, is one of the world's largest producers of gold and copper in the world. It is operated by PT Freeport Indonesia, an affiliate of Freeport-McMoRan Copper and Gold, Inc. Operations began in the 1960's and 1970's with the construction of basic infrastructure including an entire road system. Today, the nearby town of Tembagapura exists because of this mining operation. This community had to be constructed from the ground up by Freeport. Virtually nothing in the way of modern infrastructure or conveniences existed in this region of sparsely populated jungle. By the year 2007 Freeport had invested over $5 billion USD to build the required infrastructure including towns, power generation, seaports, airports, roads, bridges, modern communications, and water treatment facilities. The long-term plan for this infrastructure is to turn it over to the Indonesian government after mining efforts have completed. When these activities are examined through Maslow's Hierarchy it becomes apparent that actions appeal to the most base of human needs. The actions address the Physiological needs of Food, Water, Sleep, Homeostasis, and Excretion.

Security is an important aspect for any business and community. To manage this, Freeport employed 750 internal unarmed security personnel as of 2008. The costs to maintain this security force in 2008 was approximately $22.5 million USD. Security of Body and Property is assured through the internal security force which provides a safe working environment and protects mine property.

The Grasberg Mining complex represents a substantial asset to the Indonesian government. As such, the government has vested interest in ensuring the security of this asset. In 2008 Freeport's expenses for local government-provided Freeport financed security measures was $8.1 million USD. This security force comprised of personnel ranging from Coast Guard to Air Force totaled about 1,860 individuals. These forces work towards providing a safe worksite and local community. These activities address the need for Security of Family as this security force is responsible for responding to civil disturbances in the area which could negatively affect the community and its families.

Security of Resources is also attributed to the provision of the security force in the region by securing the mineral resources that are a national asset.

It is one thing to say a town would not have existed without a mine; it is quite another to say the town will continue to thrive after mining has concluded, which is Freeport's goal. Investments in basic social infrastructure are a large portion of Freeport's commitment to the town of Tembagapura. These include the creation of schools, dormitories, hospitals, clinics, places of worship, and recreational facilities. Security of Health is provided for by the creation of local social healthcare. In more recent history, an effort to foster sustainable practices has been made by Freeport. Businesses have been fostered that draw upon the locals' natural abilities and passions. This ensures an economic basis to draw upon outside of mining operations. One example of this is the sponsorship of Aitomona sewing enterprise group in 2008 (Freeport, 2008). This training program allows for the women from local villages to teach each other sewing techniques, provides business skills, and draws upon their talents. They provide goods, such as uniforms to the local schools. Besides the direct employment by the mine Security of Employment is also accounted for by the fostering of local sustainable businesses independent of mining that can continue even after the end of the mine's life.

In 2011 the Grasberg Mining Complex saw the strike of many of the miners. The reason for the strike was for an increase in pay. Many things should be considered before weighing the merit of the strike, including the relative standard of living, and other socially provided benefits to name a few. The recent protests can be explained by the shift of prioritization of needs further up Maslow's Hierarchy. Having a presence in this location for a long period of time has led to the basic needs to be less of a concern, and in turn a rise in saliency of the desire for more personal income. Wage increases are to be expected and a good business plan will account for them. However, the timing of strikes cannot always be predicted and unexpected wage increases are part of the risk of doing business. This is not to imply that all strikes are unfounded or without warrant.

Newmont Ghana Gold Limited, Brong Ahafo Region, Ghana

Newmont Mining Corporation engages in substantial mining activities in the Brong Ahafo region in Ghana. These activities were preceded by many years of due diligence in which the company researched the existing communities and stakeholders'

needs. The indigenous communities subsisted on minimal farming practices and the introduction of mining would radically change these activities in a number of ways. The most obvious would be the reallocation of the land itself into a mine site which would temporally remove portions of land historically dedicated to farming. Although resettlement was required, several initiatives were put into place to reduce the disturbance of the affected individuals. These initiatives not only financially compensated individuals for their land but also provided new homes and schools. Another initiative was the Agricultural Improvement and Land Access Program. This program's purpose was to assist farmers in the restarting process on new land. It boasts a 95% retention rate of individuals who are now farming on new land using more efficient planting and harvesting techniques (Kapstein and Kim, 2011). A potential threat to a base physiological need for food was turned in the mine's favor by aiding the reestablishment of farms with the added value of more efficient farming techniques.

Newmont partnered with the Ahafo Social Responsibility Forum to establish the Newmont Ahafo Development Foundation (NADeF). This foundation is dedicated to the development and improvement of the community. Through this foundation Newmont has been able to fund projects ranging from libraries, schools, dormitories, public restrooms, and water wells, to a number of scholarships for local students. These projects are prioritized based on the community's self-perceived needs. These needs are voiced through meetings with the community and tribal leaders who represent the community as a whole. (NADeF, 2012) Again physiological needs are met for water, homeostasis, and excretion. Security of health was also provided through this initiative by the creation of clinics in the area. HIV/AIDS is a large concern in Ghana, and educational efforts were made to help protect from the spread of infection.

Where mining jobs raise the standard of living for those individuals returning to farming afterwards, it would in turn lower the standard of living those individuals would be afforded by mining jobs. The foundations to support sustainable jobs after mining activities needed to be laid. The local economic condition was evaluated to determine if activities independent of the mine could be bolstered. This would mean encouraging other businesses such as brick production to foster a diverse economy that would not be entirely reliant upon mining practices. To this end technical education on small-scale

brick kiln operation was conducted. An important aspect of Newmont's presence in this region was how the company went about developing a local supply chain required to keep the mine operating. This undertaking brought about the formation of the Ahafo Linkages Program, founded in partnership with the International Finance Corporation. Before construction began the local economic, business, and social conditions were surveyed for suitability for providing a local supply chain. This survey process acknowledged areas in the local communities that could benefit from economic improvement. Local suppliers were identified that could benefit from a capacity expansion that would directly enable them to be better positioned to win bids from Newmont as well as other large regional companies. These areas became the focus the Ahafo Linkages Program with the intentions of creating an economic situation that was not completely reliant upon mining activities in the region (Mehta, 2009). Maslow's need for security of employment was provided short-term through mining jobs and long-term through the fostering of local sustainable businesses independent of mining to aid in the security of employment even at the end of the mine's life.

Although the case from Ghana shares some similarities to the Indonesian case in the framework of Maslow's hierarchy of human needs, it also has some important distinctions. Appeals started at two base levels of human need but not as drastically as would be required when virtually no infrastructure is present. In Ghana, communities and towns were already established and had a long standing way of life.

Developed Regions

The identification of needs in underdeveloped areas is easier than in highly developed areas. With many of the basic needs supplied by society and established communities the question becomes: "What can a mining company provide to their neighbors to improve their lives?" Should a mining company be obligated to provide what could be considered wants rather than needs? With the more primal needs met, the natural tendency is to desire the lacking needs higher up in the hierarchy. Higher appeals should be made if a community is to see benefit in a mining operation's presence. It is not a question of obligation but rather one of motivation, motivating a community to see value in the presence of a mine.

Martin Marietta Materials

Martin Marietta Aggregates is the second largest provider of aggregates in the United States and can trace its roots back to 1939. Aggregate quarries are vital to communities as they provide the literal foundations on which they are built. In many cases these quarries were located as close as possible to the sources they were providing materials to, while still maintaining a reasonable amount of buffer zone from the nearest neighbors. As the communities they serve grow, the proximity of the closest neighbors becomes a concern. Providing the raw materials for communities is no longer justification for existence in the eyes of many of these neighbors. It is seen time and time again when expansion permits are rejected by local ordinances, zoning authorities, and city boards on the grounds of neighbor complaints and objection (Lusk, 2011). Martin Marietta has taken the initiative to become a good neighbor by taking part in philanthropic and community projects.

One of the more successful events was an open house at an underground quarry in Ames, Iowa. Radio personalities from the local radio station WHO 1040 were invited to broadcast their show from within the mine. Tours were offered to anyone who was interested and throughout the day over 3,000 individuals were guided through the quarry. Many of these individuals had made the journey from around the state and even from nearby states. The event not only provided a fun activity for neighbors to take part in but it was also informative, providing visitors an appreciation of what a mine is truly like (Martin Marietta, 2004). This activity caters to the Need for Entertainment and the Need for Knowledge, both of which fall under the tier of Self Actualization. Another appeal to the highest rung on Maslow's Hierarchy can be seen in another of Martin Marietta's actions. The Smithsonian hosts an online exhibit called The Dynamic Earth. Contributions from Martin Marietta and other aggregate companies helped make the "Rocks and Mining" portion of this exhibit possible. This website has information about aggregate mining and its role for providing the materials from which cities are built (Smithsonian, 2012).

In 2003, Martin Marietta was a key sponsor for the 13th annual America's Walk for Diabetes held at Sea World in San Antonio, Texas. This event raised more than $170,000 USD for Diabetes Research. Martin Marietta has identified this problem as one

it can help with finding a solution (Martin Marietta, 2004). This last example is an appeal to the Security of Health through supporting research for a cure to a disease.

Martin Marietta takes part in local and regional philanthropy and community advocacy activities. These activities target general health concerns, disparities or provide some form of entertainment for the local public and vary from region to region. These general charities and aid target larger problems found across the United States, not just the populations around the quarries.

US Peabody Energy

The last of the case studies will concentrate on Peabody Energy's efforts with a focus on their attention to supporting education in the United States. With the basic infrastructure required by communities in the US already in place, Peabody has chosen to improve the social capital of the communities its operation affects. Social capitol covers the different aspects of social relations and cooperation between different social networks within a society. Peabody goes about strengthening social capitol by forming relationships between themselves and members of communities and identifying avenues where financial support can be extended to those individuals to improve some aspect of society. One can immediately see where supporting teachers and educators in communities would directly benefit society. The idea is simple. Peabody is in the business of mining so by partnering with the experts in other fields in society they can directly contribute to improving these other fields (Peabody Energy, 2012).

Peabody makes a concerted effort to invest in the next generation. This is evident in their efforts supporting academic programs at all levels including K-12 and secondary level. In 2010 Peabody contributed roughly $7 million towards these efforts and other community improvement projects. Although in the past many of Peabody's efforts are focused at schools in the St. Louis, Missouri area, recently they have been expanding to areas around their other operations (Peabody Energy, 2012). This effort provides, on a broad level, to the Self Actualization Need of Knowledge.

Aside from financial support, Peabody takes part promoting and empowering individuals who take part in the education system. Each year individuals from the educators sector are identified through an open nomination process. Those who are contributing above and beyond to the development of the youth they are involved with

are honored through recognition and a monetary grant. Through this initiative, the Need for Esteem is appealed to. Like Martin Marietta, Peabody Energy also appeals to higher needs in the community. Peabody's corporate mantra is the support of the next generation through improved education.

Discussion of Maslowian Explanations

Identifying targeted areas of benefit for regions that are underdeveloped is easier for two reasons. First the needs that could be met by a mining company are often undisputed for their necessity for life. Second, meeting these needs can be easily measured. Tangible assets can be built and their benefits can be measured. This measurability is advantageous both when proposing improvements to communities and in estimating the mine feasibility.

Developed regions tend to have a well established infrastructure foundation that provides for the basic human needs as well as safeguards in place (police, military, firefighters, and emergency medical services), which provide for many of the safety needs desired by individuals. This precludes the opportunity to introduce these improvements and as such it is more difficult to target areas of benefit. Appeals are then made to higher needs. From the examples presented in this chapter it can be seen that although there are appeals to the higher needs, they are fewer in number and perhaps not appropriate for motivating the immediate communities to accept their presence. As is evidenced by negative media portrayal, and difficulty for mining companies to gain permits, bonding and expansions in developed countries. This is perhaps due to the confusion as to what a community requires when it already has its basic needs met. The mentality of "what can the mine do for its neighbors" could be an unpopular one from the company's point of view in a capitalist society, especially when these activities have no accounted benefit to the bottom line. "The mine provides jobs, what more do they want?" Maslow derived that individuals are ever-wanting creatures. Once baser needs have been satisfied to sufficient degrees, higher needs in turn become salient. This is Maslow's human condition that motivates individuals. The question becomes whether or not the actions presented here by companies in developed areas are appropriate for motivating the communities around the mines, according to this theoretical framework.

With the exception of the open house in a quarry, all of the appeals are targeted at a broad and at times national target instead of the nearby stakeholders. A negative to the focus of national efforts is the alienation of immediate neighbors to whom no immediately perceived needs are being provided for by the mines. These efforts are therefore not appropriate for incentivizing immediate stakeholders according to this theoretical framework. Efforts need to be tailored towards the perceived needs of the immediate communities.

With the exception of the fundraiser for diabetes, all efforts were targeted at very high needs on the hierarchy. Appealing too high on Maslow's Hierarchy bears the burden of lack of universal fulfillment. That is to say what it takes to fulfill the need of self actualization can be quite different from individual to individual and one must make sure there is some level of consensus amongst the targeted community as to what that may be. These efforts may serve a purpose when stockholders are viewing the company or the company is being reviewed on a national level. Whereas basic infrastructure has a fixed cost, higher level appeals programs require planning, management, and personnel dedicated to providing solutions to perceived needs and thus incentivizing immediate neighbors to support the mining company.

Often the proposal of a mining operation will produce a perceived threat to needs currently fulfilled, such as the loss of use of water wells, farmland, or hunting grounds. When currently met needs are perceived to be threatened individuals are incentivized to oppose the operation. Newmont providing aid to farmers whose land was being mined by reestablishing them on new land and teaching them more efficient farming techniques is an example of what can be done when mining activities do pose a hindrance to maintaining currently met needs. While other times these perceived threats are misconceptions, they none the less inspire opposition. It is in these instances that the concerns of the community must be directly addressed. For many individuals insuring that their way of life will not be disturbed by mining is enough for them to not oppose it.

The axiom provided in this section is that the methods of using Maslow's Hierarchy is one means of identifying and means of incentivizing communities to support mining companies. Using Maslow's hierarchy actions can be logically structured and

evaluated for appropriateness. This framework can be used to rule out ideas as well as lead to them through the following steps:

- Investigate areas of potential benefit to the public around a proposed mine site.

- Investigation of populations residing around mining operations and proposed operations to learn of views and concerns about mining activities.

- Conduct a landscape assessment of best practices by similar industries with similar demographic populations.

- Design plans to create areas of benefit tailored to specific needs, wants, and concerns of nearby public.

- Address concerns where mining activities are perceived to be a threat to currently met needs.

Include the costs of these activities in the mine feasibility study.

Appealing directly to areas of perceived need allows for communities to be involved in the mining planning process in a meaningful way. Meaningful involvement goes hand in hand with open dialog and efforts to educate the communities surrounding mine sites about the benefits that mining could provide. Much of this investigation can be done with the help of existing local non government organizations, which operate regularly within and have built a rapport with the community. Philanthropy created with good intent in a corporate board room does not address disparities and needs held by immediate neighbors.

This approach provides the mining industry with a theoretical framework for creating opportunities for community improvement, thereby incentivizing the community to support proposed mining activities.

6.3 Technical Shifts to Foster Positive Perceptions

The technologies implemented at each mine site, for the extraction of the minerals within the reserve, directly affect the perceptions of the public. By the same logic one can expect changes in these technical implementations to shift perceptions or bring about consent from the public. That is to say when mountain top removal (MTR) is practiced at

a coal mine in Appalachia then that mine and mining company sees increased criticism by anti-mining entities. This increased criticism leads to events such as increased regulation towards MTR by the Environmental Protection Agency (EPA) or financial backers to pull funding for MTR projects, as PNC Bank recently did. MTR is a form of mining that bears a large amount of negative public sentiment which may ultimately lead to its demise. Without the consent of the public, a form of mining may possibly cease to exist.

Should not then an alternate technical solution, that has the approval of the public, be implemented? Of course this question cannot be answered without a detailed technical evaluation of each site. But assume for the sake of the argument that several technical implementations exist for each site. The primary evaluation tool currently used mainly considers the economic factors of all phases of the mining process. The process which minimizes costs and maximizes returns is selected. One important caveat to be noted is that the social and ethical responsibility of maximizing the recovery from reserves should not be forgotten. Every effort must be made to not waste the reserve in the name of profit and public opinion alike. This introduces a novel school of thought which expands the process of mine design to include the customer (public). A redesigning of mines based on public perception. This allows for the application of technology based solutions that address local needs and constraint criteria.

Open dialog with communities allow for the ability to gain knowledge of local circumstances, relationships, values, and priorities. This process can also allow for the identification of disparities around the mine itself (Cooney, 2001). Much like any other site condition challenges that must be overcome by the employment of different mining techniques and technologies pre-existing, socio-environmental challenges can be overcome through proactive initiatives.

When a mining company is considering a new operation, paying attention to the role that the concept of Environmental Justice plays in the feasibility study, mining activity, and closure of a mine, can expedite the permitting process in the United States. Considering the needs of the communities affected by mining activities would do well to guide the due diligence that the EPA calls for through Environmental Justice. These are best identified from the views and opinions of the immediate public.

Mining companies can play a proactive role in heading off criticism framed by EPAs EJ 2014 Plan through several avenues highlighted by the plan itself. The sub-strategy of "Considering Environmental Justice in Permitting" calls for creating meaningful opportunities for the public to have access to the permitting process. First in this process is the identification of who the public is. The public is mentioned over 100 times in EJ 2014 and yet it is not defined by the EPA. The mining industry would do well to proactively define who the public is as it relates to Environmental Justice. One definition would be any stakeholder in the proximity of the operation that would be impacted by the mining activity. During this process the company's plans for mining are communicated to those impacted by mining activities. This form of engagement is often weak due to the fact that the company is dictating actions and simply being receptive to concerns. A more meaningful engagement would be including stakeholders in the actual planning process. A relevant planning process that a community could have a meaningful impact upon would be the reclamation process as this will be the lasting effect incurred by the community. Learning what a community would like to see happen to the land after mining has concluded and committing to that would be means to gaining that community's support for the mining operation. Northumberlandia in the United Kingdom is an example of how a mining operation created a landform sculpture on reclaimed mining land and turned it into a community park (Northumberlandia, 2012). Open dialog with the communities and immediate public gauging their attitudes, needs, and wants will be the way to determine areas of potential benefit. When these activities are conducted beforehand a much stronger case can be built for a permit. This process will also potentially create individuals in the local communities who become strong advocates of the mine. Through community activism, local populace can be armed with better arguments than "the mining company creates jobs." The sooner the argument of jobs vs. environment is replaced with arguments that directly address the critiques levied against mining the better.

6.3.1 Community Engagement Framework

While it is easy to state that meaningful involvement of the community can play a critical role in the permitting process for a new mine, following through with this involvement is not an easy task. Structured Public Involvement (SPI) is a developed

protocol for involving communities in project planning decisions and could be readily applied to the mining industry. SPI was developed by Dr. Keiron Bailey and Dr. Ted Grossardt for the purpose of collecting quality public input about public transportation projects (Bailey, Brumm & Grossardt, 2001). The purpose of SPI is to bring about stakeholder satisfaction with potential projects by allowing controlled input from the stakeholders. It was designed and intended for democratic societies that have come to expect a voice in public projects. While mining operations are not in the domain of public projects, the fundamental process outlined by SPI can be useful for collecting feedback from the immediate public around mining operations. The authors of SPI are clear in stating what SPI is meant to do and what SPI does not do.

<div align="center">"What SPI Does</div>

- Provides an analytic framework that allows public values to be better understood by professionals
- Uses public and professional time more efficiently, resulting in less conflict
- Allows professionals to generate solutions relevant to the community in question
- Increases public satisfaction with process and product by handling public goods allocation in accord with the principles of a representative democracy – proven by large-scale, real-time, anonymous public satisfaction polling during the process
- Strengthens appreciation of democratic mechanisms for planning and risk allocation

<div align="center">What SPI Does not do</div>

- Turn the complete design domain over to the public
- Create more need for public involvement to solve problems created by poorly structured input
- Force "consensus" in large-scale and contentious processes when this is practically unachievable
- Allow individuals, either public demagogues or professionals with a predetermined "best" option, to dominate and shape outcomes in opposition to majorities
- Eliminate all disagreement and objection to proposals" (Grossardt, 2013)

The general SPI process is made up of a series of seven sequential steps , and are as follows (Grossardt, Bailey & Brumm, 2003):

1. Define design scope - During this step, with the aid of stakeholders, conditions for successful resolution are defined. By getting all stakeholders on board with an agreed upon definition of what an outcome product should embody, opposing factions pushing for their idea of a design outcome can be unified.

2. Define parameters of design problem - Parameters that govern the specific design options. These parameters or concerns would be the impacts of the project. Identifying them through initial outreach to representative stakeholders takes place during this step. These parameters guide engineering professionals in their planning and designing alternative approaches to projects.

3. Define decision terrain - Not all parts of the project should be subject to public interjection due to the technical considerations required to produce alternative options. The public, however, can play a role in weighing the alternative options for a design based on their perceived value of the impacts of the options. This step outlines when the public will be consulted and when technical professionals will take these consultations into consideration. Evaluation procedures are created in this step to measure how well their design options address the defined parameters created in the previous step. This feedback provides confidence to both the professionals and the public that progress is being made and consensus is being worked toward.

4. Create public solicitation process - Once the decision terrain has been defined and it has been decided what information is to be collected from the public, then the means of collecting this information can be determined. This involves design professionals defining the means by which the parameters defined in the second step are addressed and introducing the various technologies utilized to do so. Introducing these to the public would take place in workshop or community forum settings where feedback could be solicited and each option could be evaluated by the attendees.

5. Document public feedback for design team - The SPI process stresses the importance of documenting how the design process is in part guided by the public input. This allows the design team to rule out extremely unpopular options and focus on the more accepted solutions. This documentation is also important for transmission purposes to the stakeholders in the form of websites or other distributable media.

6. Design alternatives - Unlike other public involvement methods that start with the presentation of fully rendered design alternatives that are voted between, SPI

starts with basic public preferences towards general technical solutions. Once these preferences are documented, the designs of alternative solutions are made.

7. Review, revise, redesign - These alternative design solutions guided by initial community feedback are then introduced to the community in the same manner as the previous step. These designs are revealed as a technological means of achieving what the community felt was important. Feedback on each option is again collected and used to further tailor the project. The last three steps are often conducted over several iterations and lead to meaningful engagement of the community and means for establishing trust in the community.

This process was developed originally for the use in planning projects that made use of public funding; therefore, public interaction and input seems only logical. This process can be adopted for the professionals designing and permitting a mine as well. Even though a mine is not a public asset, it can affect the nearby public both in positive and negative ways. Given the fact that the United States has a democratic society, its citizens expect a say in just about everything. The mining industry has been fighting this tendency and perhaps through structured engagement this confrontation can be turned to resolution. The following is an application of the SPI process to a mine design process. Perhaps this is a process that should even be taught in capstone mining engineering courses.

1. Define design scope - With the aid of relevant stakeholders, conditions for resolution are defined. Relevant stakeholders to a mining operation would include: land owner(s), mining engineers, regulators, locally elected officials, immediate neighbors to the property, representatives from the labor force, and representatives from advocacy groups, should there be any. While definitions of successful resolutions would have to be decided from group to group and site to site some examples are: "A mine design that would be low impact to the local air quality", or "A mining method that would produce a desired post mining land use."

2. Define parameters of design problem - Parameters that govern specific design options of a mine site could include: specific air quality standards and means of measurement, ground vibration limits from blasting, preservation of specific land

or water formations, protection of specific flora or fauna, or even the number of expected jobs to be created by the mining activity.

3. Define decision terrain - Not all parts of the project should be subject to public interjection. This is especially true when considering the extraction of a finite resource. Mining engineers and mining companies have an ethical obligation to maximize extraction and minimize loss of a deposit. The public, however, can voice their perceived value of alternative mining methods or technological options that are designed to accomplish the same job at similar levels of efficiency.

4. Create public solicitation process - The communities near to these proposed mine projects could be invited to meetings and polled about the various mining methods possible for the extraction of the mineral deposit in question. Examples of what different mining methods look like both during extraction and post-mining, and pertinent information as it relates to the defined design parameters would be communicated to the audience and feedback would be solicited. By demonstrating through past examples how different mining methods can achieve the parameters laid out by the stakeholders, a sense of cooperation is instilled in those involved. Feedback could be collected via audience response devices known as "clickers." Structured questions are posed to the audience and responses are given anonymously through wireless keypads distributed to the members of the audience.

5. Document public feedback for design team - Documentation of the community meetings would be useful for the mining engineers designing a project, showing due diligence on permitting applications, and transparent feedback to the community.

6. Design alternatives - With initial guidance from the community and relevant stakeholders, time and resources can begin to be allocated to the expensive process of detailed mine design planning.

7. Review, revise, redesign - With these designs created, additional meetings with the community could be held. At these meetings, detailed mine designs and visual renderings of each mine process will be required to educate the attendees about each mine method option. Other design tradeoffs will be communicated,

such as increased cost, job creation, and safety considerations. Reclamation options and post-mine purpose will be discussed as well. If the local community has a particular use in mind for the mine land after mining has concluded, then this should be considered from the beginning of the mine's life and design plans should accommodate this. Again, feedback is solicited and collected. Feedback on each option is used to further tailor the project. These last three steps are repeated until a resolution is agreed upon or no additional progress is being made.

7.0 Conclusions and Future Work

7.1 Conclusions

Despite the necessary role that mining plays in our world, there is a disconnect between this role and the public's perception of mining. This needs to be communicated to the public in order to educate them, and the publics' attitudes toward mining need to be identified so misinformation can be accurately targeted. Though the public's perspective of mining may be negative, it is argued that these sentiments of negativity are not deeply rooted like religion or moral code. This is because most of the information about mining comes from "softer" sources like entertainment or news media that the public consumes. With communication targeted at the concerns held about mining, these opinions can be shifted as explained though Social Judgment Theory. This targeting has been made possible by the formative research at the heart of this work. The public's level of knowledge about mining has been determined and quantified for three Kentucky counties through a survey.

Companies stand to benefit from a positive public perception but few have the resources to commit towards improving it. No single company alone has the resource to support an education effort to make every individual aware of the importance of mining. If the US mining industry as a whole is to stay competitive in a global market, it must have the support of the American public. The problem facing the mining industry is not limited to one company alone, so combating the problem should not be the sole responsibility of any one company, but rather the industry as a whole.

Towards laying foundations for aiding this effort, the following conclusions can be made from this body of work.

- Positive Attitudes about mining increased as the level of mining around the samples surveyed increased.
- Combining results from attitude questions and knowledge questions can guide the selection of educational messages.
- As an individual's knowledge about mining increases so do their positive attitudes towards mining; therefore, educating the public with the facts about mining is recommended.

- There is an upward trend between an individual's self-report of knowledge about mining and their knowledge scores about mining.
- Differences in attitudes have been measured between subsamples defined by the seven following areas: county of residence, age, gender, political party affiliation, education level, household income before taxes, and relationship to somebody involved with mining.
- A multiple regression model was developed that uses household income, political party, relationship to a person in the mining industry, and age to predict knowledge of mining, of which 31.7% of the variance is accounted for.
- Attitude ratios and knowledge scores are different for groups that have performed specific actions that can affect the mining industry.
- Individuals take political candidates pro-mining stance towards mining into account and vote for them based on that stance.

The populations around mining activities should be addressed in a different manner than the general public, and the methods of addressing each group requires its own theoretical approach. The theoretical frameworks of Social Judgment Theory and Maslow's Hierarchy of Human Need have been applied to the mining industry for the general public and communities near mining operations, respectively. By applying inappropriate tactics to the wrong populations, efforts and resources are wasted. As a case in point, consider the educational efforts that take place in Appalachia. Due to the high ego-involvement that the denizens of this region have in mining, these individuals are probably firmly entrenched in their attitudes about mining. Simple educational messages will probably have little chance of changing their views. The resources to conduct these outreach efforts are probably better spent in other areas.

It is important to properly communicate the success and improvements of the mining industry in recent history to properly educate the American public about mining. This, however, is not enough for the communities directly affected by mining. These improvements can be heralded in with site specific community engagement. Positive perceptions of mining can be fostered by bringing the local communities needs into the mine design process.

With these conclusions and theoretical frames, more educated choices can be made by both companies and regional grassroots organizations alike. The messages communicated on behalf of the mining industry should be ones which directly address the concerns of the majority rather than what it is that the industry feels that the public should know about mining. This is the mentality the mining industry needs to adopt if it is to continue to survive in the current American atmosphere.

7.2 Novel Additions

The first major contribution to the mining industry is that of free and open survey results from the current study, which was conducted in Kentucky. These results would be valuable for companies and grassroots outreach organizations that lack the resources to invest in such a survey. Specific guidance's to these efforts include:

- Prioritization of needed messages based on the public's tested knowledge on specific questions
- The purpose of educational efforts has been substantiated based on the actions performed by individuals with more knowledge and more positive attitudes toward mining.
- Specific attitude ratios and knowledge scores targets associated with actions have been measured and reported.

Another contribution to the mining industry is the development of the survey tool and theoretical framing for improving mining's image efforts for education and outreach on behalf of the mining industry. These tools are useful for public relations representatives who have to regularly attend and hold public meetings. Identifying the population that the outreach is intended for is critical for deciding how to tailor the efforts. Educating members of the public that are extremely anti-mining as well as members who are already pro-mining should be addressed in different ways than those without much involvement in the mining industry. Social Judgment Theory and Maslow's Theory of Human Needs have been applied to these different populations to alleviate the problem of negative public perception.

Another path to solving the problem of negative public perception was briefly discussed. This path will be that of site specific technological implementation changes

that are supported by the public. This work proposes a novel school of thought which expands the process of mine design to include and take into account public perception. This allows for the application of technology solutions that address local needs and constraint criteria.

7.3 Future Work

The following are recommendations for future work that could be conducted to continue this research:

- The survey used in this work should be conducted in other regions, or ideally on the national level, to test if the relationships and correlations found in this work are generalizable to other samples of the population.

- Educational materials that address the area of negative attitudes or knowledge gaps should be identified and tested to see if they are able to improve attitudes or close the knowledge gaps. This testing should be framed and measured using the Social Judgment Theory framework to confirm the usefulness of the SJT model.

- The expansion of the mine design process taught in mining engineering programs to include the concept of Structured Public Involvement should be considered.

- Case studies should be conducted on greenfield mining projects (projects in the initial phases) where Maslow's hierarchy is used to frame community incentivization efforts for bringing about community support of the project.

Appendix A: Full Survey Script

*** QUESTION #1 ***
*Dummy to pull FIPS
  GO TO Q. #2   ====> <1> [3]##
-- NUMERIC OPEN END - RANGE IS 21000 THRU 21999 --
-- ANSWER REQUIRED --

*** QUESTION #2 ***
 Hello, my name is [I]## and I am calling from the University of
 Kentucky Survey Research Center. I am calling to ask for your
 participation in an important survey about the public's attitudes and knowledge about
mining. This will take about 10 minutes and your telephone number was chosen
randomly by a scientific sampling process, so all of the information you give us will be
kept strictly anonymous. The data will be used to help find out what the public thinks
about mining.

 My instructions are to speak with the person in this household who is 18 or older and has
had the most recent birthday. Would that be you? OR, Would you call that person to the
phone? (Repeat intro if necessary)
  GO TO Q. #3   ====> <1> Yes, Continue
 DISP CODE #1   ====> <2> No answer
 DISP CODE #2   ====> <3> Phone busy
 DISP CODE #3   ====> <4> Disconnected phone
 DISP CODE #4   ====> <5> Business/government phone
 DISP CODE #6   ====> <6> Initial refusal
 DISP CODE #7   ====> <7> Computer tone
 DISP CODE #8   ====> <8> Language problems
 DISP CODE #9   ====> <9> Schedule callback
 DISP CODE #14 ====> <10> No eligible respondent
 DISP CODE #11 ====> <11> Answering Machine
 DISP CODE #15 ====> <12> Respondent not available for duration

*** QUESTION #3 ***
 If I have your permission, let me begin by asking what county you live in?
  GO TO Q. #4   ====> <1> Harlan
  GO TO Q. #4   ====> <2> Johnson
  GO TO Q. #4   ====> <3> Lincoln
 DISP CODE #14 ====> <4> Other
 DISP CODE #14 ====> <5> #
 DISP CODE #14 ====> <6> #
 DISP CODE #14 ====> <7> #
 DISP CODE #14 ====> <8> DK
 DISP CODE #14 ====> <9> REF

*** QUESTION #4 ***
Can you think of a person or persons who works in the mining industry?
  GO TO Q. #5 ====> <1> Yes
  GO TO Q. #6 ====> <2> No
  GO TO Q. #6 ====> <3> #
  GO TO Q. #6 ====> <4> #
  GO TO Q. #6 ====> <5> #
  GO TO Q. #6 ====> <6> #
  GO TO Q. #6 ====> <7> #
  GO TO Q. #6 ====> <8> DK
  GO TO Q. #6 ====> <9> REF

*** QUESTION #5 ***
Who is the person closest to you that works in the mining industry?
  GO TO Q. #6 ====> <1> Myself
  GO TO Q. #6 ====> <2> Immediate Family (Brother Sister Mother Father Son Daughter)
  GO TO Q. #6 ====> <3> Relative
  GO TO Q. #6 ====> <4> Friend
  GO TO Q. #6 ====> <5> Neighbor
  GO TO Q. #6 ====> <6> Acquaintance
  GO TO Q. #6 ====> <7> Other
  GO TO Q. #6 ====> <8> DK
  GO TO Q. #6 ====> <9> REF

*** QUESTION #6 ***
The following are statements that could be made about mining. For each state if you Strongly Disagree, Somewhat Disagree, Somewhat Agree, or Strongly Agree with the statement. First:

*** QUESTION #7 ***
Mining companies are not environmentally conscientious.
  GO TO Q. #8 ====> <1> Strongly Disagree
  GO TO Q. #8 ====> <2> Somewhat Disagree
  GO TO Q. #8 ====> <3> Somewhat Agree
  GO TO Q. #8 ====> <4> Strongly Agree
  GO TO Q. #8 ====> <5> #
  GO TO Q. #8 ====> <6> #
  GO TO Q. #8 ====> <7> #
  GO TO Q. #8 ====> <8> DK
  GO TO Q. #8 ====> <9> REF
-- SPECIAL FEATURE * SHUFFLING QUESTIONS (3) --
   BEGINNING WITH QUESTION 7 AND
   ENDING WITH QUESTION 23 --

*** QUESTION #8 ***

The mining process includes cleaning up after mining is done.

  GO TO Q. #9   ====> <1> Strongly Disagree
  GO TO Q. #9   ====> <2> Somewhat Disagree
  GO TO Q. #9   ====> <3> Somewhat Agree
  GO TO Q. #9   ====> <4> Strongly Agree
  GO TO Q. #9   ====> <5> #
  GO TO Q. #9   ====> <6> #
  GO TO Q. #9   ====> <7> #
  GO TO Q. #9   ====> <8> DK
  GO TO Q. #9   ====> <9> REF

*** QUESTION #9 ***

Mining does not affect that much land.

  GO TO Q. #10 ====> <1> Strongly Disagree
  GO TO Q. #10 ====> <2> Somewhat Disagree
  GO TO Q. #10 ====> <3> Somewhat Agree
  GO TO Q. #10 ====> <4> Strongly Agree
  GO TO Q. #10 ====> <5> #
  GO TO Q. #10 ====> <6> #
  GO TO Q. #10 ====> <7> #
  GO TO Q. #10 ====> <8> DK
  GO TO Q. #10 ====> <9> REF

*** QUESTION #10 ***

Mining is permanently damaging to the environment.

  GO TO Q. #11 ====> <1> Strongly Disagree
  GO TO Q. #11 ====> <2> Somewhat Disagree
  GO TO Q. #11 ====> <3> Somewhat Agree
  GO TO Q. #11 ====> <4> Strongly Agree
  GO TO Q. #11 ====> <5> #
  GO TO Q. #11 ====> <6> #
  GO TO Q. #11 ====> <7> #
  GO TO Q. #11 ====> <8> DK
  GO TO Q. #11 ====> <9> REF

*** QUESTION #11 ***

Communities around mines are good places to live.

  GO TO Q. #12 ====> <1> Strongly Disagree
  GO TO Q. #12 ====> <2> Somewhat Disagree
  GO TO Q. #12 ====> <3> Somewhat Agree
  GO TO Q. #12 ====> <4> Strongly Agree
  GO TO Q. #12 ====> <5> #
  GO TO Q. #12 ====> <6> #
  GO TO Q. #12 ====> <7> #
  GO TO Q. #12 ====> <8> DK

GO TO Q. #12 ====> <9> REF

*** QUESTION #12 ***
Mining is acceptable as long as it is carried out far from where
people live.
  GO TO Q. #13 ====> <1> Strongly Disagree
  GO TO Q. #13 ====> <2> Somewhat Disagree
  GO TO Q. #13 ====> <3> Somewhat Agree
  GO TO Q. #13 ====> <4> Strongly Agree
  GO TO Q. #13 ====> <5> #
  GO TO Q. #13 ====> <6> #
  GO TO Q. #13 ====> <7> #
  GO TO Q. #13 ====> <8> DK
  GO TO Q. #13 ====> <9> REF

*** QUESTION #13 ***
Mining companies are bad companies to work for.
  GO TO Q. #14 ====> <1> Strongly Disagree
  GO TO Q. #14 ====> <2> Somewhat Disagree
  GO TO Q. #14 ====> <3> Somewhat Agree
  GO TO Q. #14 ====> <4> Strongly Agree
  GO TO Q. #14 ====> <5> #
  GO TO Q. #14 ====> <6> #
  GO TO Q. #14 ====> <7> #
  GO TO Q. #14 ====> <8> DK
  GO TO Q. #14 ====> <9> REF

*** QUESTION #14 ***
It is safe to be a miner.
  GO TO Q. #15 ====> <1> Strongly Disagree
  GO TO Q. #15 ====> <2> Somewhat Disagree
  GO TO Q. #15 ====> <3> Somewhat Agree
  GO TO Q. #15 ====> <4> Strongly Agree
  GO TO Q. #15 ====> <5> #
  GO TO Q. #15 ====> <6> #
  GO TO Q. #15 ====> <7> #
  GO TO Q. #15 ====> <8> DK
  GO TO Q. #15 ====> <9> REF

*** QUESTION #15 ***
Mining uses up to date technology.
  GO TO Q. #16 ====> <1> Strongly Disagree
  GO TO Q. #16 ====> <2> Somewhat Disagree
  GO TO Q. #16 ====> <3> Somewhat Agree
  GO TO Q. #16 ====> <4> Strongly Agree
  GO TO Q. #16 ====> <5> #

```
  GO TO Q. #16  ====>  <6> #
  GO TO Q. #16  ====>  <7> #
  GO TO Q. #16  ====>  <8> DK
  GO TO Q. #16  ====>  <9> REF


*** QUESTION #16 ***
Mining is a thing of the past.
  GO TO Q. #17  ====>  <1> Strongly Disagree
  GO TO Q. #17  ====>  <2> Somewhat Disagree
  GO TO Q. #17  ====>  <3> Somewhat Agree
  GO TO Q. #17  ====>  <4> Strongly Agree
  GO TO Q. #17  ====>  <5> #
  GO TO Q. #17  ====>  <6> #
  GO TO Q. #17  ====>  <7> #
  GO TO Q. #17  ====>  <8> DK
  GO TO Q. #17  ====>  <9> REF


*** QUESTION #17 ***
Mining is important in many states in the United States.
  GO TO Q. #18  ====>  <1> Strongly Disagree
  GO TO Q. #18  ====>  <2> Somewhat Disagree
  GO TO Q. #18  ====>  <3> Somewhat Agree
  GO TO Q. #18  ====>  <4> Strongly Agree
  GO TO Q. #18  ====>  <5> #
  GO TO Q. #18  ====>  <6> #
  GO TO Q. #18  ====>  <7> #
  GO TO Q. #18  ====>  <8> DK
  GO TO Q. #18  ====>  <9> REF


*** QUESTION #18 ***
Mining is not important to the US economy.
  GO TO Q. #19  ====>  <1> Strongly Disagree
  GO TO Q. #19  ====>  <2> Somewhat Disagree
  GO TO Q. #19  ====>  <3> Somewhat Agree
  GO TO Q. #19  ====>  <4> Strongly Agree
  GO TO Q. #19  ====>  <5> #
  GO TO Q. #19  ====>  <6> #
  GO TO Q. #19  ====>  <7> #
  GO TO Q. #19  ====>  <8> DK
  GO TO Q. #19  ====>  <9> REF


*** QUESTION #19 ***
Mining creates a lot of good jobs.
  GO TO Q. #20  ====>  <1> Strongly Disagree
  GO TO Q. #20  ====>  <2> Somewhat Disagree
  GO TO Q. #20  ====>  <3> Somewhat Agree
```

GO TO Q. #20 ====> <4> Strongly Agree
GO TO Q. #20 ====> <5> #
GO TO Q. #20 ====> <6> #
GO TO Q. #20 ====> <7> #
GO TO Q. #20 ====> <8> DK
GO TO Q. #20 ====> <9> REF

*** QUESTION #20 ***
Mining does not contribute significantly to Americans standard of living.
GO TO Q. #21 ====> <1> Strongly Disagree
GO TO Q. #21 ====> <2> Somewhat Disagree
GO TO Q. #21 ====> <3> Somewhat Agree
GO TO Q. #21 ====> <4> Strongly Agree
GO TO Q. #21 ====> <5> #
GO TO Q. #21 ====> <6> #
GO TO Q. #21 ====> <7> #
GO TO Q. #21 ====> <8> DK
GO TO Q. #21 ====> <9> REF

*** QUESTION #21 ***
Products of mining are used to make almost everything I use on a day-to-day basis.
GO TO Q. #22 ====> <1> Strongly Disagree
GO TO Q. #22 ====> <2> Somewhat Disagree
GO TO Q. #22 ====> <3> Somewhat Agree
GO TO Q. #22 ====> <4> Strongly Agree
GO TO Q. #22 ====> <5> #
GO TO Q. #22 ====> <6> #
GO TO Q. #22 ====> <7> #
GO TO Q. #22 ====> <8> DK
GO TO Q. #22 ====> <9> REF

*** QUESTION #22 ***
America would be worse off without mining.
GO TO Q. #23 ====> <1> Strongly Disagree
GO TO Q. #23 ====> <2> Somewhat Disagree
GO TO Q. #23 ====> <3> Somewhat Agree
GO TO Q. #23 ====> <4> Strongly Agree
GO TO Q. #23 ====> <5> #
GO TO Q. #23 ====> <6> #
GO TO Q. #23 ====> <7> #
GO TO Q. #23 ====> <8> DK
GO TO Q. #23 ====> <9> REF

*** QUESTION #23 ***
 Mining is important to me.
  GO TO Q. #24 ====> <1> Strongly Disagree
  GO TO Q. #24 ====> <2> Somewhat Disagree
  GO TO Q. #24 ====> <3> Somewhat Agree
  GO TO Q. #24 ====> <4> Strongly Agree
  GO TO Q. #24 ====> <5> #
  GO TO Q. #24 ====> <6> #
  GO TO Q. #24 ====> <7> #
  GO TO Q. #24 ====> <8> DK
  GO TO Q. #24 ====> <9> REF

 *** QUESTION #24 ***
 The next set of questions are to find out what people know about mining. If you don't
know the answer, just give your best guess.

First, How much would you say you know about mining in the US, overall?
 Would you say:
  GO TO Q. #25 ====> <1> No Knowledge
  GO TO Q. #25 ====> <2> Very Little Knowledge
  GO TO Q. #25 ====> <3> Some Knowledge, or
  GO TO Q. #25 ====> <4> A Good Deal of Knowledge
  GO TO Q. #25 ====> <5> #
  GO TO Q. #25 ====> <6> #
  GO TO Q. #25 ====> <7> #
  GO TO Q. #25 ====> <8> DK
  GO TO Q. #25 ====> <9> REF

 *** QUESTION #25 ***
 Reclamation is defined as:
  GO TO Q. #26 ====> <1> The first step in mining where trees and topsoil are
removed.
  GO TO Q. #26 ====> <2> Extracting minerals from the ground.
  GO TO Q. #26 ====> <3> Restoration of mined land to original contour, use, or
condition.
  GO TO Q. #26 ====> <4> Refining gold from ore.
  GO TO Q. #26 ====> <5> #
  GO TO Q. #26 ====> <6> #
  GO TO Q. #26 ====> <7> #
  GO TO Q. #26 ====> <8> DK
  GO TO Q. #26 ====> <9> REF
 -- SPECIAL FEATURE * SHUFFLING QUESTIONS (3) --
   BEGINNING WITH QUESTION 25 AND
   ENDING WITH QUESTION 34 --
 -- SPECIAL FEATURE * SHUFFLING ANSWERS
   ALL BUT LAST TWO ANSWERS --

*** QUESTION #26 ***

What percentage of land has mining disturbed in America? Would you say:
  GO TO Q. #27 ====> <1> 0%
  GO TO Q. #27 ====> <2> 0.5% (Half of 1 percent)
  GO TO Q. #27 ====> <3> 5%
  GO TO Q. #27 ====> <4> 50%
  GO TO Q. #27 ====> <5> #
  GO TO Q. #27 ====> <6> #
  GO TO Q. #27 ====> <7> #
  GO TO Q. #27 ====> <8> DK
  GO TO Q. #27 ====> <9> REF

*** QUESTION #27 ***

How much does the average miner earn each year? Would you say:
  GO TO Q. #28 ====> <1> $25,000
  GO TO Q. #28 ====> <2> $40,000
  GO TO Q. #28 ====> <3> $65,000
  GO TO Q. #28 ====> <4> $100,000
  GO TO Q. #28 ====> <5> #
  GO TO Q. #28 ====> <6> #
  GO TO Q. #28 ====> <7> #
  GO TO Q. #28 ====> <8> DK
  GO TO Q. #28 ====> <9> REF

*** QUESTION #28 ***

Of these four professions which do you think is the most dangerous?
Would you say:
  GO TO Q. #29 ====> <1> Agricultural Industry
  GO TO Q. #29 ====> <2> Forestry Industry
  GO TO Q. #29 ====> <3> Retail Industry
  GO TO Q. #29 ====> <4> Mining Industry
  GO TO Q. #29 ====> <5> #
  GO TO Q. #29 ====> <6> #
  GO TO Q. #29 ====> <7> #
  GO TO Q. #29 ====> <8> DK
  GO TO Q. #29 ====> <9> REF
-- SPECIAL FEATURE * SHUFFLING ANSWERS
  ALL BUT LAST TWO ANSWERS --

*** QUESTION #29 ***

How many more years can mining continue in the United States? Would you say:
  GO TO Q. #30 ====> <1> 5 Years
  GO TO Q. #30 ====> <2> 10 Years
  GO TO Q. #30 ====> <3> 50 Years
  GO TO Q. #30 ====> <4> 100 Years
  GO TO Q. #30 ====> <5> #

```
  GO TO Q. #30  ====>  <6> #
  GO TO Q. #30  ====>  <7> #
  GO TO Q. #30  ====>  <8> DK
  GO TO Q. #30  ====>  <9> REF
```

*** QUESTION #30 ***
How many states have mines? Would you say:
```
  GO TO Q. #31  ====>  <1> 10
  GO TO Q. #31  ====>  <2> 20
  GO TO Q. #31  ====>  <3> 30
  GO TO Q. #31  ====>  <4> 50
  GO TO Q. #31  ====>  <5> #
  GO TO Q. #31  ====>  <6> #
  GO TO Q. #31  ====>  <7> #
  GO TO Q. #31  ====>  <8> DK
  GO TO Q. #31  ====>  <9> REF
```

*** QUESTION #31 ***
What percentage of the US Gross Domestic Product is mining responsible for? Would you say:
```
  GO TO Q. #32  ====>  <1> 1%
  GO TO Q. #32  ====>  <2> 4%
  GO TO Q. #32  ====>  <3> 10%
  GO TO Q. #32  ====>  <4> 25%
  GO TO Q. #32  ====>  <5> #
  GO TO Q. #32  ====>  <6> #
  GO TO Q. #32  ====>  <7> #
  GO TO Q. #32  ====>  <8> DK
  GO TO Q. #32  ====>  <9> REF
```

*** QUESTION #32 ***
How many miners are in the US? Would you say:
```
  GO TO Q. #33  ====>  <1> 25,000
  GO TO Q. #33  ====>  <2> 100,000
  GO TO Q. #33  ====>  <3> 500,000
  GO TO Q. #33  ====>  <4> 5 Million
  GO TO Q. #33  ====>  <5> #
  GO TO Q. #33  ====>  <6> #
  GO TO Q. #33  ====>  <7> #
  GO TO Q. #33  ====>  <8> DK
  GO TO Q. #33  ====>  <9> REF
```

*** QUESTION #33 ***
How many pounds of mined material does the average American use every year? Would you say:
```
  GO TO Q. #34  ====>  <1> 400 lbs
```

GO TO Q. #34 ====> <2> 4000 lbs
GO TO Q. #34 ====> <3> 40,000 lbs
GO TO Q. #34 ====> <4> 400,000 lbs
GO TO Q. #34 ====> <5> #
GO TO Q. #34 ====> <6> #
GO TO Q. #34 ====> <7> #
GO TO Q. #34 ====> <8> DK
GO TO Q. #34 ====> <9> REF

*** QUESTION #34 ***
What is the number one source of electricity in the US? Would you say:
GO TO Q. #35 ====> <1> Coal
GO TO Q. #35 ====> <2> Hydroelectricity
GO TO Q. #35 ====> <3> Nuclear
GO TO Q. #35 ====> <4> Wind farms
GO TO Q. #35 ====> <5> #
GO TO Q. #35 ====> <6> #
GO TO Q. #35 ====> <7> #
GO TO Q. #35 ====> <8> DK
GO TO Q. #35 ====> <9> REF
-- SPECIAL FEATURE * SHUFFLING ANSWERS
   ALL BUT LAST TWO ANSWERS --
*** QUESTION #35 ***
The next few questions are true or false. Again, if you are not sure, just give your best
guess. First:

*** QUESTION #36 ***
Mining companies take environmental impact into account when planning a mine.
GO TO Q. #37 ====> <1> True
GO TO Q. #37 ====> <2> False
GO TO Q. #37 ====> <3> #
GO TO Q. #37 ====> <4> #
GO TO Q. #37 ====> <5> #
GO TO Q. #37 ====> <6> #
GO TO Q. #37 ====> <7> #
GO TO Q. #37 ====> <8> DK
GO TO Q. #37 ====> <9> REF
-- SPECIAL FEATURE * SHUFFLING QUESTIONS (3) --
   BEGINNING WITH QUESTION 36 AND
   ENDING WITH QUESTION 40 --

*** QUESTION #37 ***
After mining is done the land is restored.
GO TO Q. #38 ====> <1> True
GO TO Q. #38 ====> <2> False
GO TO Q. #38 ====> <3> #

GO TO Q. #38 ====> <4> #
GO TO Q. #38 ====> <5> #
GO TO Q. #38 ====> <6> #
GO TO Q. #38 ====> <7> #
GO TO Q. #38 ====> <8> DK
GO TO Q. #38 ====> <9> REF

*** QUESTION #38 ***
Mining companies have complete control where mines can be.
GO TO Q. #39 ====> <1> True
GO TO Q. #39 ====> <2> False
GO TO Q. #39 ====> <3> #
GO TO Q. #39 ====> <4> #
GO TO Q. #39 ====> <5> #
GO TO Q. #39 ====> <6> #
GO TO Q. #39 ====> <7> #
GO TO Q. #39 ====> <8> DK
GO TO Q. #39 ====> <9> REF

*** QUESTION #39 ***
Canaries are still used to test the air in mines.
GO TO Q. #40 ====> <1> True
GO TO Q. #40 ====> <2> False
GO TO Q. #40 ====> <3> #
GO TO Q. #40 ====> <4> #
GO TO Q. #40 ====> <5> #
GO TO Q. #40 ====> <6> #
GO TO Q. #40 ====> <7> #
GO TO Q. #40 ====> <8> DK
GO TO Q. #40 ====> <9> REF

*** QUESTION #40 ***
You use the products of mining on a day to day basis.
GO TO Q. #41 ====> <1> True
GO TO Q. #41 ====> <2> False
GO TO Q. #41 ====> <3> #
GO TO Q. #41 ====> <4> #
GO TO Q. #41 ====> <5> #
GO TO Q. #41 ====> <6> #
GO TO Q. #41 ====> <7> #
GO TO Q. #41 ====> <8> DK
GO TO Q. #41 ====> <9> REF

*** QUESTION #41 ***
Now for some basic information about you so we can compare responses across different households.
.
What year were you born?
.
[DK=888; REF=999]
  GO TO Q. #42 ====> <1> Numeric
-- NUMERIC OPEN END - RANGE IS 888 THRU 1994 --
-- ANSWER REQUIRED --

*** QUESTION #42 ***
[INTERVIEWER: RECORD GENDER; ASK ONLY IF UNSURE]
  GO TO Q. #43 ====> <1> Male
  GO TO Q. #43 ====> <2> Female
  GO TO Q. #43 ====> <3> #
  GO TO Q. #43 ====> <4> #
  GO TO Q. #43 ====> <5> #
  GO TO Q. #43 ====> <6> #
  GO TO Q. #43 ====> <7> #
  GO TO Q. #43 ====> <8> DK
  GO TO Q. #43 ====> <9> REF

*** QUESTION #43 ***
Which political party do you most identify yourself with?
.
[IF RESP. SAYS INDEPENDENT, ASK IF THEY LEAN TOWARD THE
DEMOCRATS OR REPUBLICANS]
  GO TO Q. #44 ====> <1> Democrat
  GO TO Q. #44 ====> <2> Independent Leaning Democrat
  GO TO Q. #44 ====> <3> Independent
  GO TO Q. #44 ====> <4> Independent Leaning Republican
  GO TO Q. #44 ====> <5> Republican
  GO TO Q. #44 ====> <6> Other
  GO TO Q. #44 ====> <7> #
  GO TO Q. #44 ====> <8> DK
  GO TO Q. #44 ====> <9> REF

*** QUESTION #44 ***
What is the last grade you completed in school?
  GO TO Q. #45 ====> <1> Grade School Only
  GO TO Q. #45 ====> <2> Some High School
  GO TO Q. #45 ====> <3> High School or GED
  GO TO Q. #45 ====> <4> Associates
  GO TO Q. #45 ====> <5> Bachelors of Arts
  GO TO Q. #45 ====> <6> Bachelors of Science

```
 GO TO Q. #45  ====>  <7> Masters
 GO TO Q. #45  ====>  <8> PhD
 GO TO Q. #45  ====>  <9> MD
 GO TO Q. #45  ====>  <10> #
 GO TO Q. #45  ====>  <11> DK
 GO TO Q. #45  ====>  <12> REF
```

*** QUESTION #45 ***

Last year, what was your total household income from all sources before taxes?
.

[READ CATEGORIES IF THEY DO NOT VOLUNTEER ANSWER]
```
 GO TO Q. #46  ====>  <1> Under $5,000
 GO TO Q. #46  ====>  <2> $5-$7,500
 GO TO Q. #46  ====>  <3> $7,500-$10,000
 GO TO Q. #46  ====>  <4> $10-$12,500
 GO TO Q. #46  ====>  <5> $12,500-$15,000
 GO TO Q. #46  ====>  <6> $15,000-$20,000
 GO TO Q. #46  ====>  <7> $20-$25,000
 GO TO Q. #46  ====>  <8> $25-$30,000
 GO TO Q. #46  ====>  <9> $30-$40,000
 GO TO Q. #46  ====>  <10> $40-$50,000
 GO TO Q. #46  ====>  <11> $50-$70,000
 GO TO Q. #46  ====>  <12> $70-$90,000
 GO TO Q. #46  ====>  <13> $90-$120,000
 GO TO Q. #46  ====>  <14> Over $120,000
 GO TO Q. #46  ====>  <15> DK
 GO TO Q. #46  ====>  <16> REF
```

*** QUESTION #46 ***

What is your race or ethnicity?
```
 GO TO Q. #48  ====>  <1> White
 GO TO Q. #48  ====>  <2> African American
 GO TO Q. #48  ====>  <3> American Indian, Eskimo, or Aleut
 GO TO Q. #48  ====>  <4> Asian or Pacific Islander
 GO TO Q. #48  ====>  <5> Hispanic
 GO TO Q. #48  ====>  <6> Some other race
 -- ABOVE ANSWER ASSOCIATED WITH OPEN END QUESTION #47 --
 GO TO Q. #48  ====>  <7> #
 GO TO Q. #48  ====>  <8> #
 GO TO Q. #48  ====>  <9> DK
 GO TO Q. #48  ====>  <10> REF
```

*** QUESTION #47 ***

Other race, ethnicity.
.

[DK=98; REF=99]

*** QUESTION #48 ***
Just a few more quick questions.
.
Have you ever made a formal complaint against a mining company?
.
[IF YES: "WAS THAT IN THE PAST 5 YEARS OR MORE THAN 5 YEARS AGO?"]
  GO TO Q. #49 ====> <1> No
  GO TO Q. #49 ====> <2> In the past 5 Years
  GO TO Q. #49 ====> <3> More than 5 Years
  GO TO Q. #49 ====> <4> #
  GO TO Q. #49 ====> <5> #
  GO TO Q. #49 ====> <6> #
  GO TO Q. #49 ====> <7> #
  GO TO Q. #49 ====> <8> DK
  GO TO Q. #49 ====> <9> REF

*** QUESTION #49 ***
Have you ever voted for a political candidate because of their
pro-mining position?
.
[IF YES: "WAS THAT IN THE PAST 5 YEARS OR MORE THAN 5 YEARS AGO?"]
  GO TO Q. #50 ====> <1> No
  GO TO Q. #50 ====> <2> In the past 5 Years
  GO TO Q. #50 ====> <3> More than 5 Years
  GO TO Q. #50 ====> <4> #
  GO TO Q. #50 ====> <5> #
  GO TO Q. #50 ====> <6> #
  GO TO Q. #50 ====> <7> #
  GO TO Q. #50 ====> <8> DK
  GO TO Q. #50 ====> <9> REF

*** QUESTION #50 ***
Have you ever voted for a political candidate because of their
anti-mining position?
.
[IF YES: "WAS THAT IN THE PAST 5 YEARS OR MORE THAN 5 YEARS AGO?"]
  GO TO Q. #51 ====> <1> No
  GO TO Q. #51 ====> <2> In the past 5 Years
  GO TO Q. #51 ====> <3> More than 5 Years
  GO TO Q. #51 ====> <4> #
  GO TO Q. #51 ====> <5> #
  GO TO Q. #51 ====> <6> #
  GO TO Q. #51 ====> <7> #
  GO TO Q. #51 ====> <8> DK
  GO TO Q. #51 ====> <9> REF

*** QUESTION #51 ***
Have you ever attended a pro-mining rally?
.
[IF YES: "WAS THAT IN THE PAST 5 YEARS OR MORE THAN 5 YEARS AGO?"]
  GO TO Q. #52 ====> <1> No
  GO TO Q. #52 ====> <2> In the past 5 Years
  GO TO Q. #52 ====> <3> More than 5 Years
  GO TO Q. #52 ====> <4> #
  GO TO Q. #52 ====> <5> #
  GO TO Q. #52 ====> <6> #
  GO TO Q. #52 ====> <7> #
  GO TO Q. #52 ====> <8> DK
  GO TO Q. #52 ====> <9> REF

*** QUESTION #52 ***
Have you ever attended an anti-mining rally?
.
[IF YES: "WAS THAT IN THE PAST 5 YEARS OR MORE THAN 5 YEARS AGO?"]
  GO TO Q. #53 ====> <1> No
  GO TO Q. #53 ====> <2> In the past 5 Years
  GO TO Q. #53 ====> <3> More than 5 Years
  GO TO Q. #53 ====> <4> #
  GO TO Q. #53 ====> <5> #
  GO TO Q. #53 ====> <6> #
  GO TO Q. #53 ====> <7> #
  GO TO Q. #53 ====> <8> DK
  GO TO Q. #53 ====> <9> REF

*** QUESTION #53 ***
Is there anything else that you would like to mention about mining that we did not ask about?
.
[NO=97; DK=98; REF=99]
  GO TO Q. #54 ====> <1> Open End
-- MULTI-PUNCH --

*** QUESTION #54 ***
Those are all the questions I have. Thank you for your time!

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Work Experience

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Undergraduate Research Assistant for the University of Missouri-Rolla – Rolla, MO, **March-Aug 2005**
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Honors

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- 2008-2009 UKSEE Student Chapter — President
- 2003-2007 UMR Trustees Scholarship
- 2004-2005 Rocky Mountain Coal Mining Association Scholarship
- 2004-2007 Waring Guy Mining Scholarship
- 2006 Caterpillar Excel-Mining Scholarship
- 2006 Pollard, Arthur Mining Scholarship
- 2006 Michelin Mining Essay Contest
- 2007 Peabody Energy's Operations Management Scholarship
- 2006-2013 ISEE Foundation Scholarship
- 2011 University of Kentucky Mining Department's Outstanding Graduate Student Award
- 2011, 2012 SME WAAIME Scholarship

Publications

Refereed Journal Articles

1. Hoffman, J.M., B. Lusk, K. Perry, "Investigations of Shock Tunnel Dynamics and Energy Realization." Blasting and Fragmentation Volume 3 Number 3 December 2009. (ISSN: 1937-6359). ISEE, Cleveland, OH. Pp. 207-226.

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3. Lusk, B., K. Perry, J. Hoffman, "Laboratory Investigation of Layered Aluminum Mesh for Blast Mitigation Purposes Using an Arena Test Setup." Journal of Battlefield Technology Volume 13 Number 2 July 2010. (ISSN: 1440-5113) Argos Press. pp. 1-12.

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6. Lusk, B., J. Hoffman, "Analysis of Survey Information about Airblast and Ground Vibration Reporting Units." International Journal of Mining, Reclamation and Environment Volume 25 Number 2, June 2011. (ISSN 1748-0930) Taylor & Francis. pp. 161-176.

7. Lusk, B., J. Silva Castro, J. Hoffman, K. Eltschlager, "A Public Relations Plan Based on Structure Generated Sounds and Public Input." The Journal of Explosives Engineering, Vol. 28, No. 1, January 2011, pp 34-43.

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9. Lusk, B. J.M. Hoffman, J.J. Silva Castro, W.C. Wedding, E.G. Morris, J. Calnan, "Evaluation of Emergent Electronic Detonators and Modern Non-Electric Shocktube Detonators Accuracy." Blasting and Fragmentation Volume 6 Number 1 June 2012. ISEE, Cleveland, OH pp. 1-18.

10. Hoffman, J. M., B. Lusk, "The Environmental Justice Critique of the Mining Industry" 2013 Transactions of the Society for Mining, Metallurgy and Exploration, Inc., Volume XXX, 2012, SME Littleton, CO (UNDER REVIEW).

11. Hoffman, J. M., B. Lusk, "Applying a Classical Human Needs Theory to the Mining Industry." 2013 International Journal of Mining, Reclamation and Environment., Volume XXX, (ISSN 1748-0930) Taylor & Francis (UNDER REVIEW).

12. Johnson, C.E., B. Lusk, J.M. Hoffman, J. Rathbun, "Surface Coal Mine Blasting Optimization and Mitigation of Environmental Impacts: Mine to Fill." 2013 Environmental Considerations in Energy Production, ARIES Symposium, SME Littleton, CO (UNDER REVIEW).

13. Lashgari, A., C. Johnson, V. Kecojevic, B. Lusk, J.M. Hoffman, "NOx Emission of Equipment and Blasting Agents in Surface Coal Mining." 2013 Transactions of the Society for Mining, Metallurgy, and Exploration, Inc., Volume XXX, SME Littleton, CO (UNDER REVIEW).

Refereed Conference Papers and Presentations

1. Hoffman, J., B. Lusk, K. Perry, "Investigation of Shock Tunnel Dynamics and Energy Realization." "Proceedings of the Thirty-Fifth Annual Conference on Explosives and Blasting Technique." Denver, CO, February 8-11, 2009, 11 pgs.

2. Perry, K., B. Lusk, J.M. Hoffman, "Field Testing of Aluminum Mesh for Blast Mitigation Properties." "Proceedings of the Thirty-Fifth Annual Conference on Explosives and Blasting Technique." Denver, CO, February 8-11, 2009, 11 pgs.

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4. Mulligan, P., J.M. Hoffman, "Effects of Run-up on an Explosively Formed Projectile" "Proceedings of the Thirty-Sixth Annual Conference on Explosives and Blasting Technique." Orlando, FL, February 7-10, 2010, 10 pgs.

5. Lusk, B., C. Wedding, J.M. Hoffman, "Influence of Environment on Explosively Driven Shock Waves in Air." "Proceedings of the Thirty-Seventh Annual Conference on Explosives and Blasting Technique." San Diego, CA, February 6-9, 2011.

6. Lusk, B. C. Wedding, J.M. Hoffman, J., "Electronic Detonator and Modern Non-Electric Shocktube Detonator Accuracy." "Proceedings of the Thirty-Seventh Annual Conference on Explosives and Blasting Technique." San Diego, CA, February 6-9, 2011.

7. Rathbun, J., D. McLane, B. Lusk, J.M. Hoffman, "Shock Tunnel Waveform Analysis." "Proceedings of the Thirty-Seventh Annual Conference on Explosives and Blasting Technique." San Diego, CA, February 6-9, 2011.

8. Mulligan, P., J. Baird, J.M. Hoffman, "The Effects of the Flyer Plate's Radius of Curvature on the Performance of an Explosively Formed Projectile." "Proceedings from the Seventeenth Biennial International Conference of the American Physical Society Topical Group on Shock Compression of Condensed Matter Conference." Chicago, IL, June 26-July 1, 2011.

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